THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

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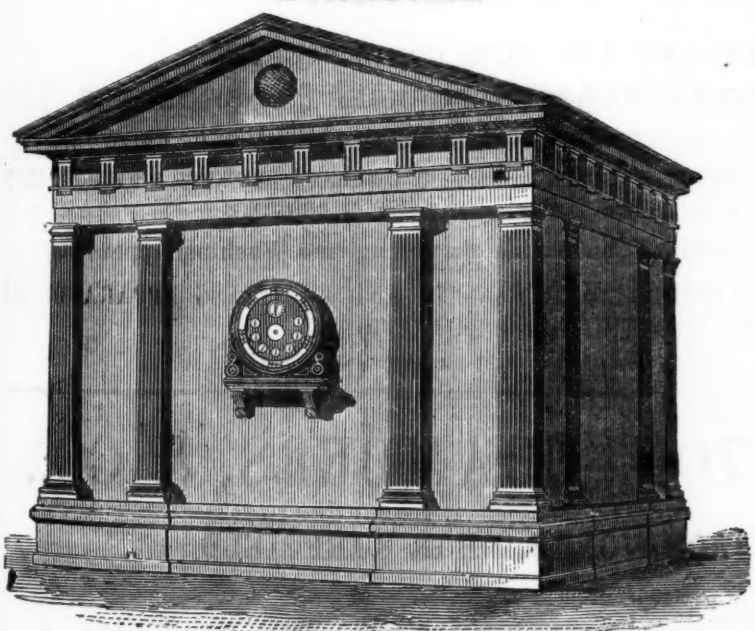

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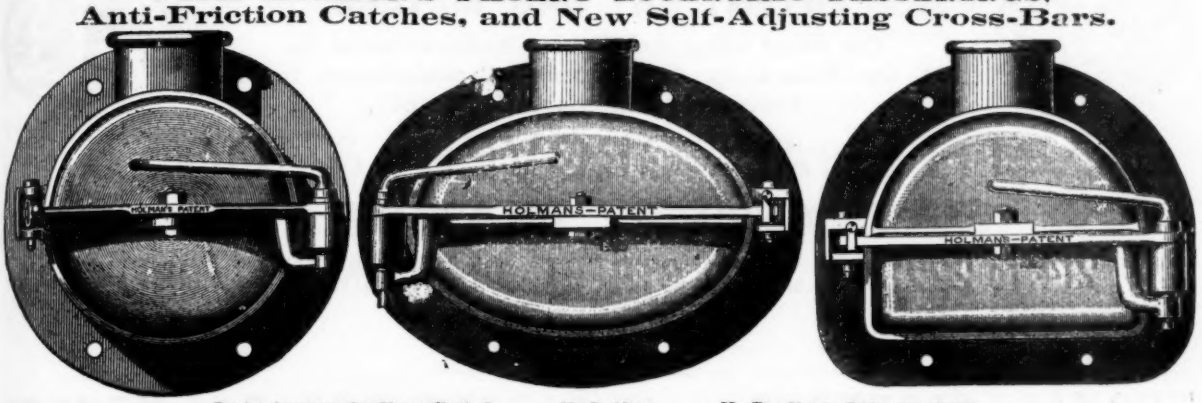

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Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

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In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

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TESTIMONIAL.

The Gaslight and Coke Company,
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Yours truly,
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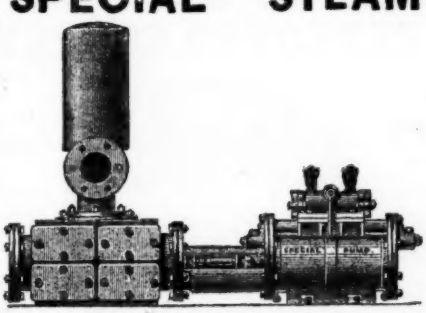
Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	20
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



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TANGYE'S HIGH-PRESSURE AND CONDENSING STEAM-ENGINES; CORNISH, VERTICAL, & TUBULAR BOILERS; HYDRAULIC AND SCREW LIFTING-JACKS, CRABS, PULLEY-BLOCKS, &c.

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Dublin, 1865.

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

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THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
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5th, Are the most accurate and unvarying measurers of Gas;
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7th, May be fixed either above or below the level of the Lights;
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10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

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(ESTABLISHED 1816,)

MANUFACTURERS OF

WET & DRY METERS,

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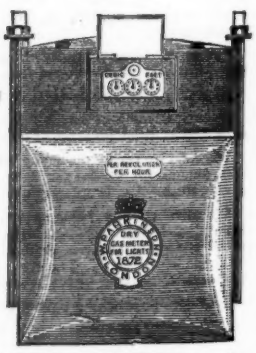

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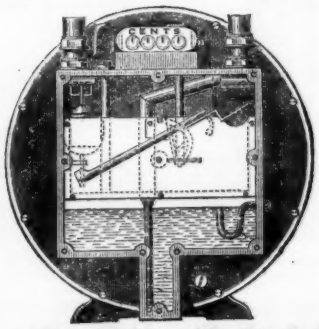
In this Meter, the action of the measuring-drum is reversed. By this arrangement an improvement is effected in the registration at high speeds, which, in many tests, has not varied from the smallest light to three times the capacity of the meter. It works equally well under all pressures. The range of error between the high and low line is much smaller than that allowed by the "Sale of Gas Act."



The Meter has been critically tested, and most favourably reported upon by official Meter Inspectors in London and Birmingham.

W. PARKINSON and CO. have made arrangements for the manufacture of these Meters, both in tin and cast-iron cases, and for the alteration of old ones to this principle, which is confidently recommended as possessing every quality that can be desired by Gas Companies, Corporations, or Private Consumers.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

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NOTICE TO SUBSCRIBERS.

BANK HOLIDAY.—*In consequence of the Bank Holiday next week, the* JOURNAL *will not be published till Wednesday, Aug. 7.*

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

W. M.—*If you refer to Newbigging's "Gas Manager's Hand-Book," 2nd Edition, p. 153, you will see that "each degree of Twaddel is equal, as nearly as possible, to 2 ounces of acid per gallon of the liquor." Hence 4° represents about 8-oz. liquor.*

J. T., Inverness.—*Referring to the answer given to this correspondent in the* JOURNAL *of the 16th inst., Mr. C. Read, the Manager of the Redhill Gas Company, writes: "I notice in last week's* JOURNAL *some one at Inverness asking your opinion about using ammoniacal liquor for making iron cement, I may state that I have used it for years, and prefer it before water."*

H. FRANCIS, Devonport; SECRETARY; A BELGIAN GAS ENGINEER.—*Too late for insertion this week.*

TO SUBSCRIBERS.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the second half of the year 1878, are reminded that this can only be done during the present month.

Cloth cases for binding the JOURNAL may be obtained on order from any Bookseller, or from the office; but the Publisher cannot receive the numbers to bind for Subscribers.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 30, 1878.

Circular to Gas Companies.

WE rather complained last week that sufficient pains had not been taken to introduce the electric light to the Metropolis, nor, indeed, to any other large town in England. We cannot say that the projectors and inventors have since proposed to do anything in the way, or with the object, of convincing the British public of the beauty or the advantages of the light. But this we notice, that an eminent chemical firm are advertising for tenders from Town Corporations, Gas Companies, and Capitalists, for the purchase of the whole or part of the Jablochkoff patents for this country. We think it unfortunate that, before advertising for the sale of the patents, the complete success of M. Jablochkoff's candle invention had not been demonstrated. Buying patents for inventions, the utility of which has not been publicly shown, is very much like "buying a pig in a poke." We fear that we cannot, under present circumstances, recommend Gas Companies, even if they had the power, to enter into a speculation of this kind; Corporations may do as they like. Granting, as we have before said, that there is an undoubted future for the electric light, and that the Jablochkoff candle may in time become the means of spreading the illumination, it must be clear to every one that the inventor has not yet advanced so far as to have made his instruments a continuous source of uninterrupted light. It must be remembered that, before all things, it is necessary that artificial light should be supplied without any break of continuity. Gas, except under extraordinary circumstances, fulfils these conditions; the electric candle, as it stands at present, does not, as the candles require to be frequently renewed. The last improvement we saw was two beautifully made carbon poles, with a kaolin insulator, which, we were told, would require to be renewed once an hour. This will not answer for public lamps, or even for private illumination. Corporations cannot keep a lamplighter travelling about to renew candles, and Gas Companies and Consumers, as we suppose we must call them, could not afford a man to be incessantly going about to change the carbon poles. One beauty and convenience of gas is that once lighted it remains, diffusing its illuminating power so long as the light is required. The present fault of the Jablochkoff candle is that its duration is short, and whether a man has to go and put a new candle in position, or to move a commutator, it comes to just the same thing, and involves as much trouble and expense. We regard it as being a thing to be regretted, that the inventor comes before the British public with an imperfect instrument. The exercise of patience and perseverance will most likely, in the course of time, enable M. Jablochkoff to supply instruments which will fulfil all necessary requirements; but it is quite certain that much time, skill, and experimentation must be exercised before this is accomplished.

We are rather sorry to see that an extremely ingenious invention for lighting and extinguishing public gas-lamps has proved unsuccessful. When Mr. Lane Fox first started his experiments in Pall Mall, we pointed out the failures, but suggested that these might possibly be capable of remedy, and the system eventually made a success. Our hopes have not been realized; all the defects seem to have remained. Some lamps would not light at all, some would go out after they had been lighted, and a few refused to be extinguished. Naturally the Vestry of St. James's, Westminster, have been exercised in the matter, and, after due deliberation, Mr. Lane Fox has been requested by the Vestry to remove his apparatus from all the public lamps to which it has been applied. We much regret this, although we have the kindliest feeling for our old friend the lamplighter, especially when he ran through the streets with a ladder and an open torch. We have no great sympathy with the well-dressed parties who now walk complacently along and light the lamps; but even these we should regret to see disappear. The fault, we may take it, of Mr. Lane Fox's apparatus is that it is too scientific and complicated. Electricity does not always readily lend itself to simple operations. Mr. Fox will, no doubt, in time modify his apparatus, and may possibly succeed in effecting the object he has at heart. His present failure need not discourage him; he has only to take the advice which we have given to M. Jablochkoff—have patience and persevere.

In spite of the remonstrance of the Gas Company, the Southampton Town Council have resolved upon having a ten ton steam roller, and are about to apply to the Local Government Board for authority to borrow money to purchase the same. The estimated cost of the unwieldy machine is £530. What cost its use over gas and water mains may entail upon the ratepayers cannot be predicted. The machines are undoubtedly useful, and, as we have said before, beneficial to horses and riders in their carriages. When we knew Southampton well, the roads used to be exceedingly good, and it could only have been by extreme neglect that they have fallen into a condition which, as one member of the Council says, "renders them indictable."

The difficulties which Gas Companies have to encounter when their distributing plant is interfered with by the operations of Corporation workmen is shown in a rather exaggerated form in Montrose. Drainage and other works are going on in that Royal Burgh, and whatever happy results may ensue to the inhabitants in a sanitary sense, the Gas Company appear to suffer to an alarming extent. The disturbance of the ground seems to have so injured the connections of the gas-mains that leakage has occurred to the extent of fifty per cent. over that of 1874, when the drainage works were commenced. It may be that the Company have not exercised sufficient vigilance; for, if their pipes have been injured, they have a ready remedy at law. They have, we believe, the power to compel the Authorities to reinstate the mains in the condition they were before the ground was disturbed, and this right they ought to exercise.

The Town Council of Droitwich have no doubt, by this time, obtained power from the Local Government Board to borrow money for the purchase of the gas undertaking, which the Company have agreed to sell. It is a small matter; but as straws are said to show which way the wind blows, Droitwich offers an illustration of a general tendency. We do not expect that any

one in the borough will profit by the change of ownership, and we think it is not unlikely that gas may be somewhat dearer in Droitwich. At the present, however, all appear to be satisfied, and we may leave them to indulge in their delusions.

The selling price for gas stock subject to the sliding scale will always be difficult to settle. Private purchasers may make their own bargains with brokers, and these latter may put what price they like in their monthly lists; but it is at a public auction that the ideas of investors are best ascertained as to what is the real value of this class of property. A few days ago a small amount of stock in the Commercial Gas Company was sold by auction, with somewhat curious results. The next dividend will probably be ten and a half per cent., free of income-tax, and a half year's dividend was due on the stock put up for sale. The first lot of £100 realized £206; but this, which we can only call an inflated price, was not maintained. Four other lots of £100 each brought only £200 10s. each, and a balance of £88 10s. was sold at the rate of only £196 per £100 stock. We have said before that the stock sold carries the dividend of the past half year.

The correct estimation of the real amount of ammonia in gas liquor is a matter of great importance to Companies, and to Corporations having gas-works, who do not work up their own residuals. The methods which have hitherto been employed are, as we have said before, very defective and misleading. No Gas Company or Corporation would in these days dream of selling their liquor at a fixed rate per ton of coal carbonized. No less unsatisfactory is selling according to the indications of Twaddel's hydrometer and the so-called saturation test. It may be said, we think, with truth, that when gas liquor is sold by the above-mentioned tests, Gas Companies fail to realize the actual value of the article they sell. The only true test of value is the actual amount of real ammonia which the liquor contains. The method proposed by Mr. Davis in the paper which he read at the last Meeting of the British Association, as reported in another column, is practical, and, in competent hands, will yield results which may be perfectly relied upon. Except in the form of apparatus, the method does not differ from that proposed some years ago by Mr. Child, and since reproduced in our columns. Mr. Davis, however, deserves thanks for once more calling the attention of Gas Managers to the subject.

The address of Mr. Hall, the President of the North British Association of Gas Managers, will be found in another place. Taking for his text a remark made in the JOURNAL OF GAS LIGHTING, &c., the precise meaning of which he slightly mistakes, Mr. Hall goes through and gives a short account of the improvements made in the apparatus for the manufacture of gas since its first introduction. It has never been denied that enormous progress has been made in the perfection of apparatus used in the production, purification, and storeage of coal gas; still the fact remains, that the actual process continues the same as it was when somebody of Mr. Hall's acquaintance put coals into an old kettle and distilled them. The reproach, however, if it can be considered a reproach, will not much longer be thought appropriate. A start has undoubtedly been made, in which Mr. Young, of Clippens, has taken a leading part. He is being followed in the South, and we hope that the exertions of those who are now devoting themselves to the improvement of the manufacture of gas will result in giving us a larger yield of better gas per ton, and in the simplification of the means of purification.

We have received the new edition of Mr. Arthur Silverthorne's work on "The Transfer of Gas-Works to Local Authorities, "with the latest Statistics and Analyses of Working under "Municipal Management, 1868 to 1878." It arrived too late for notice this week.

Water and Sanitary Notes.

CIRCUMSTANCES, we fear, have prevented the Duke of Sutherland from cultivating what are evidently his natural bents. As a legislator, we do not remember that he has at all distinguished himself. As an amateur fireman, he has been well known in the Metropolis. He now appears in the character of a bagman, or commercial traveller, and his last move has been to endeavour to persuade the Metropolitan Board of Works to adopt General Scott's process for converting lime-treated sewage into cement at Barking or Crossness. What the Works and General Purposes Committee of the Board will say to the proposal we do not, of course, know; but we look with something like affright on the project to convert solid residue of metropolitan sewage, treated with lime, into cement. The quantity produced, supposing it to be good for anything, would be beyond all possible requirements, and the so-called Portland and Roman cements must be so reduced in price that the Thames and Medway manufacturers might shut up their works, and give up their trade in despair. We feel bound to mention here, that some specimens which we have received from Burnley seem to show that a fairly good cement may be produced by General Scott's process, but we have not yet been able to ascertain the strength of the material as indicated by the recognized modes of testing.

The inhabitants of Durham opposed to the Water Company have achieved a triumph which we did not at all expect. The parliamentary history of the Durham Water Bill is curious, and, we believe, unexampled. Introduced into the Commons, it passed a second reading and Committee without opposition. Carried up to the Lords, it again passed a second reading and Committee without opposition; but while the Bill was at this stage the townspeople became aroused, and, by some action, which would take us too long to describe, Earl Redesdale moved to recommit the Bill, with a view to a full consideration of it. We shall presently lay before our readers the evidence brought by the supporters of the Bill, and that of its opponents; but we may now say that, broadly, the question was simply this:—Should the City of Durham continue to be supplied with water from the River Wear (the water of which is said to be enormously polluted), or ought a purer source to be selected? The evidence as to the quality of the water from the Wear, which receives the drainage of 150,000 people, and is lined with mines and factories, was of the usual contradictory character, and it is not for us to decide between the expert witnesses. We have only to note that the Lords Committee declared the preamble not proved, and that there were great rejoicings in Durham when the decision was announced. An effort was very properly made to get the unopposed portions of the Bill passed separately, but this was refused *in toto*. The Company are thus left to commence afresh next session. If the water of the Wear be so objectionable as is alleged, no difficulty can be found in discovering a new source, the supply from which would be entirely satisfactory. The townspeople, flushed with triumph, are already threatening to establish a competing supply. It would be perfectly useless to do so, for the Water Company could beat them on every point; but it is for the latter to look out and endeavour to find some means of satisfying the whims of the inhabitants of the city they supply. We sincerely hope that the proceedings in this case will not form a precedent. Earl Redesdale, we know, is a dictator, but the great power he wields must be used with caution and discretion. He may inflict an enormous wrong on a Gas or Water Company without producing the smallest benefit for the consumers of either article. We say nothing of his action in this particular case, feeling fully assured that it will be before Parliament next year, when it will receive a fuller discussion than has been given to it in the present session.

There is a prospect that the dispute between the Wimbledon Local Board and the Lambeth Water Company will be amicably settled without going to arbitration. It strikes us that the requirements of the Local Authority are rather exacting. To furnish a constant supply at a pressure such as would raise the water to the top storeys of the highest house in Wimbledon would necessitate expensive pumping, and, unless careful districting arrangements were made, would involve much danger to mains, services, and fittings in the lower parts of the town. The same dangers would result, and the same expenses be incurred, if Mr. Homersham's plans were carried out. We may mention here, that a certain amount of danger to health results when the character of a water supply is suddenly changed; and we cannot help thinking that the best thing the Wimbledon Local Board can do will be to make terms with the Lambeth Water-Works Company.

A meeting of Sanitary Engineers has been held at Liverpool, under the Presidency of Mr. Deacon, the Borough Engineer. In his Inaugural Address he gave an interesting account of the sanitary condition of the district under his supervision, with a view to correct some erroneous impressions which prevail as to the causes of the high rate of mortality in Liverpool. The central portion of that borough is densely crowded, and in this fact alone we have sufficient to account for a high death-rate; but Mr. Deacon goes on to show that there is always, in Liverpool, a large floating population, peculiarly well circumstanced to spread disease. Poor emigrants from all parts of Europe, ill-fed and badly clothed, are assembled in large numbers, and closely packed together, waiting the means of transmission to America. But, after all, Mr. Deacon makes it clear that Liverpool is not exceptionally unhealthy, or, as we should say, has not an exceptionally high death-rate. In this respect the borough is no worse off than Manchester and Glasgow, which have equally high death-rates, without the same excuse. If sanitary works of the best character can make a locality

healthy, Liverpool will, in time, become a veritable Sanitarium. Perfect sewerage, impervious pavements, and a full and free supply of excellent water are already telling on the rate of mortality; and if that one great cause of disease—overcrowding—could be removed, a general state of healthiness would, no doubt, prevail. This, however, can hardly be hoped for. Circumstanced as Liverpool is, it must necessarily be crowded as long as it is prosperous. It is nevertheless gratifying to witness the success of the great efforts made by the Corporation to improve the sanitary condition of their limits.

It would appear that the additional borings now being made by the Corporation of Liverpool, at the suggestion of Alderman Bennett, at Bootle well, are not so successful as to encourage the hope that the future wants of Liverpool can be supplied from wells. There is also an objection to an increase of the well supply. The Bootle water is extremely hard, and that hardness is owing to the presence of sulphate of lime, which is not affected by Clark's process. The inhabitants of the districts supplied from the well complain, but the Corporation do not seem to be able to help. By some arrangement, which we do not understand, the district must be supplied with all hard or all soft water, and while the Committee are testing the yield of the Bootle well, Rivington water will not, of course, be supplied. We hear nothing at the present moment as to the source to which the Water Committee will go for that supply which will inevitably be required at no distant date; but we have no doubt the matter is engaging the serious attention of those who manage the water affairs of the Corporation of Liverpool.

The principle upon which charges for water shall be based are discussed by an able correspondent, in a letter which we publish in another column. Water used for trade purposes, he very properly argues, should be supplied by meter, and charged for according to the quantity used, but he looks upon a supply for purely domestic purposes in a totally different light. He considers it an entirely sanitary question, and evidently wishes to see water used without stint. There is sound sense in this argument, for, doubtless, if mean and dirty people had to buy water according to quantity, they would economize and use very little—it may be to their own prejudice and that of their neighbours. We have before mentioned the difficulty of assessing the water-rate, which is not exactly comparable to a sewerage or police rate. For these, undoubtedly, it is perfectly right that property should contribute according to its value, and we do not say that a water-rate should not be levied upon the same basis. As to whether the Legislature, when first they made the charge for water a rate on annual value, intended it as a sanitary rate, may remain an open question. We do not believe that in those days any attention was paid to sanitary matters. The rating system which obtains is eminently simple and convenient, and if Water Companies will only exercise their undoubted rights with due discretion, we feel confident that they will not be disturbed. The contention of our correspondent supplies an unanswerable argument to those who say that a water supply should be in the hands of a local authority. If the charge for water supply is to be regarded as a sanitary rate, clearly such a rate cannot be imposed by a commercial Company.

Hull Water Supply.—At the usual monthly meeting of the Hull Water-Works Committee, yesterday week, the Engineer (Mr. Maxwell) submitted the following report on the present state of the water-works funds and the estimated expenditure for the ensuing year:—"Two years ago the bank account was, as per the then Treasurer's statements, from £4000 to £5000 to the credit of the water-works; but it really was, in consequence of his and his assistant's defalcations, upwards of £8000 against the water-works. To place the account in funds and to pay for construction of new works, it was resolved to borrow an amount not exceeding £15,000. From the figures furnished me by the accountant, I find that between Feb. 28, 1877, and June 30, 1878, the amount so borrowed, in excess of loans existing at former date, was £9750, out of which was paid on construction account £8000 (including balance of Musgrave's and Smith, Pender, and Co.'s accounts, new connecting-mains for direct supply from Springhead, and extensions of piping in new streets) leaving towards paying off the amount owing to bank £1742. But the two years profits on the working of the water-works have also been accumulating, and so on the 30th of June last there was in the bank, to the credit of the water-works account, £6688. As we shall not, for a considerable time at least, be executing new works beyond what the ordinary profits of the water-works will more than meet, I recommend that as loans fall due they be not renewed, so long as there is, say, £1000 to the water-works credit in the bank. The difference in the interest between what we are paying on loans and receiving from the bank would, on the amount at present available for paying off loans, exceed £100 per annum, and it could hardly be anticipated that were money wanted for new works any difficulty would be met with in obtaining it. I have, therefore, to report that, until new works for increased supply are sanctioned by the Council, and actually commenced, I can only estimate the outlay for construction purposes during the ensuing year at, say, £1200, and this is much within the surplus of revenue over ordinary expenditure. If, as has been recommended, a system of inspection of waste be introduced by means of Deacon's meters and stopcocks on consumers service-pipes, all the balance of this surplus will doubtless be expended on the cost of the same." It was resolved to bring the question of the disposition of the surplus funds before the attention of the Finance Committee.

Correspondence.

[*We do not hold ourselves responsible for the opinions expressed by Correspondents.*]

WATER-RATES IN THE METROPOLIS.

Sir,—From the remarks which, under the head of "Water and Sanitary Notes," you made in your last number, on the subject of the Metropolitan Water Companies charges, you seem to adopt the view that the present basis of charge—*i.e.*, the rateable value of the premises supplied—is an imperfect one, and operates unjustly in particular cases, as, for instance, when the occupier of premises which have been converted from a dwelling-house into a warehouse, with the result of greatly increasing the annual value, has to pay for water in proportion to this increased value, although the quantity of water used may be much less. You thus, whilst protesting against the extravagant assertions sometimes made, both in Parliament and elsewhere, about the water companies charges, appear somewhat to encourage those who cry out that they are badly used because they have to pay for water according to the value of their premises, rather than according to the quantity they consume,

I should be glad if you would allow me to say a few words on the subject.

There are two points of view from which the domestic supply of water may be looked at when the question of payment is considered. It may be regarded commercially in the light of a useful commodity, of which each person may take as much or as little as he likes, and pay accordingly; or, it may be treated as a sanitary necessity, of which it is to the interest of all that all should have an ample supply. It is unnecessary to say that the latter is the point of view from which our Legislature, expressing the sense of the community, regards the domestic supply of water. Only when water is required for trade purposes is it treated as an ordinary commodity. If the house supply were to be treated as a merely commercial transaction—every one paying for it in proportion to the quantity he took—the poor would have to pay much more than they do at present, and the rich less; and the consequence would be that the poor would use less water, would have their dwellings and persons in a worse sanitary condition even than now, and this condition would react injuriously on the whole community. The sanitary point of view, therefore, is clearly the one from which the water supply is to be regarded. If this be admitted, it seems to me to be a corollary that all occupiers of premises should pay, not in proportion to the quantity of water they use, but in proportion to their ability to pay, this ability being measured by the value of their holdings. It may be said that the value of a person's holding is not always the correct measure of his ability to pay, and doubtless this is so; but it is the basis upon which he contributes towards the expense of all sanitary measures and other municipal undertakings. If it be once granted that a proper supply of water to every house is as much a sanitary necessity as the removal of the drainage and the refuse from a house, it seems to follow that the basis of charge should be the same. The quantity of drainage from a warehouse, for instance, may be much less than from a dwelling-house, but the warehouse may be assessed at a high rate, and the occupier pays accordingly. It is the same with the water supply. If the water were supplied by the Local Authority in the Metropolis, this would certainly be the course adopted. It is said, however, by some that a basis of charge which would be a proper one for a representative authority is not one that should be allowed to a commercial company. But, in the case of the water supply, the Companies stand in the place of the Public Authority, and if the Companies be subject, as they rightly are, to obligations imposed in the public interest, such, for instance, as the obligation to supply water gratuitously for the extinction of fires, there seems to me no reason why the basis of charge which would be adopted by the Local Authority should not be allowed to the Water Companies.

I write this simply as a householder, not having any interest in any water undertaking; but I am tired of seeing and hearing the complaints which are continually being made by persons who occupy premises of large annual value, that they are called upon to pay water-rates upon their high assessments.

Clapham, July 26, 1878. A Householder.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, July 22.

The following Bills received the Royal Assent:—Bournemouth Gas and Water; Castleford and Whitwood Gas; Cheltenham Corporation Water; East Retford Borough; Exeter Corporation Water; Exeter Gas; Forfar Water; Mansfield Commissioners Gas; Newbury Borough Extension; Radcliffe and Pilkington Gas; South Staffordshire Water; Sutton-in-Ashfield Gas; Warrington Water; Weston-super-Mare Improvement Commissioners.

Durham Water Bill.—Report from the Select Committee read: "That it is not expedient to proceed further with the Bill."

HOUSE OF COMMONS.

Wednesday, July 24.

Public Health (Ireland) Bill.—Lords amendments agreed to.

Gas Workmen's Dinner at York.—On Saturday afternoon, the 20th inst., the *employés*—numbering over 70—of the York United Gas-light Company held their annual dinner at the Grand Stand Hotel, Knavesmire. The chair was occupied by Mr. Sellers, the Company's Secretary, and the vice-chair by Mr. Cowper. Ample justice was done to a splendid "spread," put upon the table in first-rate style by Mr. Briggs, the landlord of the hotel, after which the usual loyal and other toasts were given, and, taking the whole programme into account—viz., the speeches after dinner, the outdoor games of cricket, croquet, and brasses which followed, and then, later on in the evening, the songs, with, in many cases, piano and violin accompaniments, we are almost bound to come to the conclusion, as the Chairman put it in his speech proposing "Prosperity to the Company," that the old saying, "There is nothing like leather," must, in future, be changed to something more appropriate, "There is nothing like gas."—*York Herald.*

Legal Intelligence.

SUSSEX SUMMER ASSIZES.—Saturday, July 20.
(*Before Baron* Cleasby *and a Special Jury.*)

BATTLE GAS AND COKE COMPANY *v.* FLINT.

In this case the plaintiffs sued the defendant, their late Secretary, for wrongfully detaining the books and common seal of the Board; and the defendant denied this allegation, denied his dismissal from the position of Secretary, and claimed damages for wrongful dismissal.

Mr. P. Chasemore Gates, Q.C., and Mr. A. L. Smith appeared for the plaintiffs; Mr. W. Grantham, Q.C., M.P., Mr. Prosser, and Mr. C. Hall for the defendant.

Mr. Gates, in opening the case, said that the defendant, as the former Secretary of the Company, properly had the custody of the books of the Company and their seal so long as he was Secretary. The Company formerly existed as a private company; but in 1871 they were registered under the Limited Liability Companies Act. Previous to registration defendant gave his services as Secretary almost gratuitously, but for the last few years he had had a salary of £35 per annum. He was not only the Secretary of the Company, but also a Shareholder, being a respectable inhabitant of Battle, and various members of his family were also shareholders; in point of fact, the defendant and his relations and friends held so many shares in the Company that sometimes he almost forgot his duties to the Directors, who gave their services gratuitously, the defendant attending their meetings as Secretary. The learned Counsel then entered rather fully into the disagreements between the Directors and the defendant, which ended in their ultimately dismissing him from his post, under circumstances which he detailed.

Mr. *James Hallaway*, examined by Mr. Gates, said he was Chairman of the Company. Down to 1877 defendant was Secretary, and took an active part in all affairs, sometimes in a manner distasteful to the Directors. In May, 1877, a balance-sheet was drawn up by the Directorate, and on the 17th of May a meeting was called for the purpose of adopting it and the report. A general meeting was accordingly held, witness attending as Chairman and the defendant as Secretary and Shareholder. He behaved in such a very insolent manner to witness that he left the chair in consequence, and defendant then put himself in the chair. Besides the defendant and friends, there were three others present. The Directors report stated the accounts presented showed an amount of £566 2s. 3d. in favour of the Company, which they considered very satisfactory, and recommended a dividend of 5 per cent. It also announced that the three retiring Directors were eligible for re-election. This report was then rejected, and it was resolved by the meeting that no dividend should be paid, and that no amount should be reserved on the sinking-fund account. Three fresh Directors were also elected, one of them being the son of defendant, who resided in Dorsetshire. It was further decided to recommend that the price of gas should be raised from 6s. 3d. to 6s. 8d. per 1000 feet on and after the 1st of July in that year. In pursuance of a requisition from twelve Shareholders, defendant called an extraordinary meeting on July 2, 1877, for the purpose of considering the appointment of three Directors in the place of those newly elected (on the ground that they did not possess the confidence of the Shareholders), and of discussing, and, if they thought desirable, of removing the Secretary and appointing another in his place. This extraordinary meeting was held on the date named, and witness presided by virtue of his office as Chairman. It was the largest meeting in connection with the Company ever, to his recollection, held. The question of determining the service of the defendant, as Secretary, was considered, witness proposing the following resolution, which was seconded, and carried by a show of hands:—"That the services of the Secretary and Collector of the Company be determined by a legal notice, to be prepared by the Solicitor, and signed by the Chairman of the Company, and served forthwith." He then, accordingly, served defendant with a notice to give up his post at the end of the twelve months, he having been paid up to the 31st of March, 1877. On the 25th of March, 1878, a meeting of the Directors was held, and a resolution passed, requiring the delivery up of the property of the Company from the defendant. [The minute-book, one of the subjects of the action, was here called for by the Counsel for the plaintiff, and handed in by the defendant, the resolution referred to being read therefrom.] He accordingly, on the 1st of April, made a demand upon defendant for the books, but he replied that he had a lien upon them without stating what it was, and witness failed to get the books. In pursuance of another notice, an extraordinary meeting was held on the 18th of April, for the purpose of considering the question of re-electing defendant to the secretaryship of the Company. He (witness) again presided, and it was proposed by Mr. R. M. Flint, and seconded by Mr. J. Foord, that Mr. Flint should be reinstated in his former office; the proposer of the resolution being the son of the defendant. The proposition was not carried, 88 votes being given in its favour and 90 against, proxies being used, and the defendant giving five of his own votes. [It was pointed out that this was illegal, the 39th Article of the Company's Act setting forth that no person having any personal interest in the matter at issue should be entitled to vote.] Not being re-elected, their Solicitor made demands upon the defendant for the books, seal, and documents of the Company, but without success, they still being retained by him. An honorary Secretary, Mr. Charles Shepherd, was appointed, and he still continued to act. He (witness) was unable to estimate the value of the books and accounts, because they were unable to carry on the business of the Company without great inconvenience to themselves, unless they had them; they could not be replaced for £100. They could easily procure another seal, so that this was of merely a nominal value.

Cross-examined by Mr. Hall: Had never been refused permission to see the books for the purposes of the Company. Defendant assisted witness in the preparation of the balance-sheet, and also in the general statement, although he did not believe in the legality of the proceedings at the meetings. He wrote to witness on the 16th of May, asking him to call a meeting, and defendant mentioned that this was in consequence of his ineffective summons for a previous meeting. He was not aware that defendant had since that time assisted the Company in endorsing cheques, paying wages, &c. Probably defendant might have paid wages at the request of the Manager, Mr. Wood. Had been connected with the Company since 1869, but believed defendant was one of the promoters. Did not know that defendant discharged his duties for a considerable time for a nominal sum. He thought all the people who took up the cause in opposition to himself were opposed to the interests of the Company. The majority of the 88 he believed to be either relations or nominees of defendant. Defendant said he did not agree with the report of the Directors referred to, because it was tantamount to a dividend from capital instead of interest, and told them that, instead of paying a dividend, they ought to pay instalments of loans.

Is there not an express clause in the Articles of Association that no dividend shall be paid out of capital at all?—I do not know that there is.

You are Chairman of this Company, and would be surprised to hear that there is such a clause?—No, I should not be.

And this is what you termed "distasteful," to you?—Yes.

Cross-examination continued: Defendant did point out that the Company had only a balance of £221 5s. 4d. and owed £500, as a loan, and urged that it should be paid off only by instalments. It would be defendant's duty to point out to the Directors, and remonstrate with them also, if there were matters which he considered illegal. Because the Directors told him to do an unlawful act he was not obliged to obey them. At a meeting in 1877 defendant might have objected to their paying a dividend, as the amount of the balance was not more than half of that of the previous year. Defendant was not then put in the chair at the direction of the meeting, but he believed some of those present assented to his occupying it. At the meeting, when the question of reinstating defendant was discussed, witness was sure the motion was put to the meeting and carried by two. Witness admitted that there were five votes representing certain shares against defendant in the probate of a will, but said the executors had wished the shares registered in their names. Witness recollected defendant's requesting a meeting of the Directors to transfer certain shares, and defendant left the room at their request. The shares were, however, not transferred, as they were not in possession of the seal or the register, besides which time would not permit. Did not ask him to leave the roon on account of any personal feeling respecting the persons to whom they were to be transferred, and did not tell him when he returned that they declined to sanction the transfer. It was not in consequence of the gentlemen having voted previously against the Directors that the transfers were not granted, or that they feared they would oppose them when the question of re-electing defendant came on for discussion.

His Lordship, at this juncture of the proceedings, having looked at the Articles of Association, said the defendant was not, in any way, entitled to the custody of the seal, even if he were Secretary.

Mr. Gates argued that, if the Company removed their offices without having the Register of Shareholders and the seal, they would be liable to prosecution.

His Lordship said he would strongly recommend some settlement in the case.

Mr. Grantham replied that the defendant had acted in a manner that he considered would be for the interests of the Shareholders, and expressed his willingness to come to some fair terms in the matter.

Mr. Gates remarked that the Company had simply brought the action to establish their legal rights. It was quite clear the defendant would not understand his position.

Mr. Grantham observed that, if they gave the Company back their books, they would not receive the Secretary.

Mr. *Raper*, solicitor, was called, and proved the formal demand of the books, &c., of the defendant, and the tendering of the year's salary, with some amount for disbursements.

Mr. Grantham then opened the case for the defendant, urging that the property of the Company had been kept at the house of the defendant, as the registered office of the Company, and had always been open to the Shareholders.

His Lordship said he could only direct the Jury that the plaintiffs were entitled to the return of the things, the value of which he did not know. The damages for detention would be very small, and, indeed, the value of the goods no one seemed to know.

Mr. Grantham: I shall certainly ask your Lordship to say that the damages for detention are nothing.

Mr. Gates: No doubt, upon the return of the things we seek to recover, the damages will be reduced to a nominal sum.

His Lordship: But I must give damages.

Mr. Grantham offered to consent to a verdict for 40s. damages; and he handed in the books, seal, and other documents, the whole being placed upon the table.

The question of the amount of damages was then submitted to the Jury, and they awarded 40s. damages for the detention of the property, which they valued at £55.

His Lordship declined to certify for the Special Jury, observing that the action could very well have been tried in the County Court. He entered judgment accordingly, costs to follow the event.

Miscellaneous News.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

The Seventeenth Annual General Meeting of the Members of this Association was held on Thursday, July 11, in the United College Buildings, St. Andrew's—Mr. J. Hall (St. Andrew's), President of the Association, in the chair.

The Secretary (Mr. W. Mackenzie) read the minutes of the last general meeting, as well as the minutes of the various Committee meetings which have been held during the year.

The President then said: Perhaps the only thing that requires explanation is in regard to the two prize papers, which were submitted to the meeting at Stirling. The Committee did not think either of them worthy of the prize Mr. Andrew Stewart, of Glasgow, had offered to give. The papers were sent to Mr. Stewart, who still pressed the Committee to give part of the prize, if they could not give it all, to the writer of one of the papers. As the meeting sees from the minutes, however, the Committee have decided not to have anything to do with it. They had, previous to Mr. Stewart seeing the papers, examined them, and were of opinion that they were not worthy of the prize, and they thought that it would be unbecoming and derrogatory to the dignity of the Association to step in and review what the Association had already decided. Therefore, the Committee asked Mr. Stewart to take the matter in his own hands, and left him to do as you see he has done—namely, give the £5 prize to the paper which the Committee really thought was the better of the two.

Mr. Macpherson (Kirkcaldy): Did Mr. Stewart communicate the name of the writer of that paper to the Association?

The Secretary: No; he did not.

Mr. Macpherson: I think he was entitled to do so.

The President: Would this meeting think it was taking advantage of Mr. Stewart if the Secretary was to disclose the name of the party?

Mr. Macpherson: I do not think it would be right for Mr. Mackenzie to do so.

Mr. Whimster (Perth): I think it would be unfair to the writer to do so. Mr. Stewart could do it himself.

Mr. M'Crae (Dundee): I do not think this is a matter for the Association at all. The Association declined to have anything to do with deciding this question, and they put it into Mr. Stewart's hands to do with the papers what he thought proper. Now we have nothing more to do with the question.

The President: I think the meeting should adopt the minutes which the Secretary has read.

Mr. Peebles (Edinburgh): Was there not some reflection cast upon the procedure of the Committee?

Mr. Macpherson: That is why I wished the name of the writer of the paper to be revealed. There were reflections cast on the Committee, and I think the Association should demand to know the name of the anonymous writer in the Journal of Gas Lighting.

The PRESIDENT: I believe the Secretary had some communication with that JOURNAL.

Mr. MACKENZIE: I had.

The PRESIDENT: I may say the Secretary had some communication with the Editor of the JOURNAL about the same matter, and he tells me that his replies were very unsatisfactory, so I rather fear it would not be more satisfactory again to go back to it.

Mr. MACPHERSON: You can please yourself. I raise the question in the interest of the Association, and I think there has been a slur cast upon the Association, and in an underhand way. If the writer of these letters had been a gentleman, and had anything to say, he would have put his name to the letter, and then the Association could have answered him; but, having written an anonymous letter, he put it out of our power to deal with him.

Mr. HISLOP (Paisley): I think the matter should rest where it is. No doubt the person who wrote the paper may desire to have his name known. It may be otherwise, however. He may have some feelings on the subject, and as the papers were handed over to Mr. Stewart, to do with them as he thought fit, I really think it should rest there.

Mr. MACPHERSON: Mr. Hislop refers to the feelings of the writer; but are the feelings of the Committee not to be considered? The Association is bound to defend its Committee.

Mr. M'CRAE: I still maintain that the Association has nothing to do with Mr. Stewart as an individual. I think that we, as Members of this Association, are entitled to express our opinion, very decidedly, upon any member who will write anonymous letters to any paper regarding the actions of the Committee of this Association. We do not consider the Committee immaculate or incapable of doing a wrong thing; but a man should approach the Committee straightforwardly, and say, "I think you have done me an injustice," and if they will not listen to him, that man has an opportunity of coming to the annual meeting, and of taking the voice of his professional brethren as to whether or not the Committee had done justly. In my opinion, therefore, we should support the Committee, and express disapprobation of any member, in any circumstances, applying to the JOURNAL OF GAS LIGHTING, or any other paper, in an anonymous form, so long as he has an opportunity of coming straightforwardly and manfully to state his case to his brethren.

Mr. M'GILCHRIST (Dumbarton): Suppose we unanimously decide that the name should be divulged, is the Secretary prepared to do so, because, if he is not, there is no use going further.

The PRESIDENT: I think it has been decided that it would not be courteous, or fair, or discreet, to divulge the name.

Mr. PEEBLES (Edinburgh): To meet both views, might it not be a good thing to pass a vote of thanks to the Committee, and express our confidence in the award they have given? If the Association expressed their confidence in the Committee, it might satisfy them, and the Association would not be going back on what the Committee had done.

Mr. THOMAS WHIMSTER: I think we have already done so. We have approved of the minutes. That is a sufficient justification of the actions of the Committee, and I do not think it necessary to go any further.

Mr. MACPHERSON: Did the Editor of the JOURNAL OF GAS LIGHTING refuse the name of the writer?

Mr. MACKENZIE: I did not ask the name. I felt somewhat confounded at the manner in which this anonymous correspondent wrote to the JOURNAL. I wrote a reply, which Mr. King published; but said he thought it better that the correspondence should not be continued.

The PRESIDENT: I think you have expressed your confidence in the Committee, and your disapprobation of the party who wrote the anonymous letter, and that, I think, should be satisfactory.

Mr. M'CRAE: If the dissatisfied person is present, we will accept his silence as an approval of our action.

The minutes of the last annual meeting, as well as the minutes of the various Committee meetings, were then unanimously adopted.

NEW MEMBERS.

The following gentlemen were unanimously elected Members of the Association:—

Mackenzie, D. B.	Glasgow.
Manwell, J.	Glasgow.
Mossman, T.	West Hartlepool.
Ross, A.	Burntisland.
Smith, R.	Darlington.
Steven, D.	Pittenweem.
Swan, J.	Leslie.
Thomson, J.	Inverness.

MR. STEWART'S PRIZE.

The SECRETARY read the subjoined report in reference to this matter:—"The Committee appointed for the purpose of adjudicating on the papers given in competition for the prize offered by Mr. Andrew Stewart, unanimously make their award in favour of the paper signed 'X. W. Y.,' of which the meeting approve, and resolve that the same be reported to the members at the annual meeting to be held to-day, and that the sealed envelope be then opened, and the name of the author announced. The Secretary was also instructed to return the unsuccessful paper to the author, on application being made for the same."

This minute of the Committee was unanimously approved of, and, on the sealed envelope being opened, it was discovered that the successful competitor was Mr. Robert Smith, Corporation Gas-Works, Darlington.

SCRUTINEERS.

Mr. A. Donaldson and Mr. J. Whimster were appointed to scrutinize the ballot papers, in order to ascertain who had been appointed the President, Vice-Presidents, and Members of the Committee.

The PRESIDENT then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—Allow me to welcome you to the ancient and venerable city of St. Andrew's. A wise man once said that there was no new thing under the sun, but while in this ancient city there has been witnessed many a meeting of great and influential men, I am not aware that ever, within its famous old walls or buildings, there met such an assemblage, whose aim and object is to give "light unto the world;" at least, such light as it is our business to give, and therefore I call this a new thing. And seeing, gentlemen, that we have such an historical place of meeting, and such a worthy object, it should be a stimulus for us individually to make this gathering a worthy representation of the position the North British Association of Gas Managers holds in the gas world.

And, gentlemen, while I feel proud of the honour you have done St. Andrew's, in selecting it for your place of meeting, and more so in asking me to occupy this chair, these, however, are overbalanced by the feeling of unfitness to rise to the position of President, after the many able and worthy gentlemen who have held the position before me—gentlemen who, as gas engineers and managers of large works, and whose opportunities, experiences, and special training have fitted them for being no mean authorities on matters pertaining to gas, some of which can only be learned by such experience, and which do not fall to the lot of every one. These thoughts, gentlemen, make me wish your choice had fallen on another, of larger practice and experience, and otherwise for me to draw very largely on your patience, crave your indulgence, and request you to look upon anything. I may say merely as an introduction to the more important business of the day, which will be the reading of the various papers noted in the circular, hearing any discussions these may give rise to, and the examination of models, &c., connected with gas and its manufacture in some of its various and many details.

I need not express a wish that all discussions may be conducted in a full, free, and open manner, no one member taking up too much of our time, nor any one remaining a silent spectator, but all of us endeavouring to make the proceedings profitable, and practical in their results, so that none of us may say we have met in vain, or that our time has been unprofitably spent; but this I have no fear of, as it is a very rare thing for two gas managers to meet anywhere and not exchange their views, and thus learn some new thing. And an exchange of our ideas on any subject whatever always brings us nearer to the truth, be the subject what it may, "gas" or "gospel."

As regards the progress of this Association, I do not know that I can say much. Its Members number at present 118, besides 26 Extra-ordinar Members, and 2 Honorary Members.

Allow me here to refer to the death of one of the Association's Extraordinary Members—viz., Mr. John Z. Kay, who for many years was the Engineer and Manager of the Dundee Gas-Works, and at his decease was a member of the firm of Thos. Edington and Son, Glasgow. I cannot allow this occasion to pass without recording my testimony to his kindly feeling towards managers of gas-works less favoured by position and circumstances than himself.

To-day eight gentlemen have been proposed and admitted as Members of the Association.

During the year your Committee have met, and, along with other matters, have discussed the desirability of this our annual meeting extending over two days, it being found and acknowledged by many of the members that the proceedings hustled into one day was a very unsatisfactory state of things; therefore, after due consideration, your Committee have resolved to extend this meeting over two days. To-morrow, should you approve of, or think it desirable, after a morning sitting, you can spend the afternoon, either by visiting the Tay Bridge (one of the wonders of engineering skill and commercial enterprise), or by viewing the many places of interest in St. Andrew's, to which admission can be had through arrangements that have been made to pass Members of this Association free, on presentation of the guide-book which has been distributed, bearing the title, "North British Association of Gas Managers; Meeting at St. Andrew's, July 11, 1878."

This, then, gentlemen, is the mere formal opening of our meeting to-day, but no doubt it will be expected that I should say something bearing more directly on gas matters, and, in doing so, I take for the text of my remarks a statement made in the JOURNAL OF GAS LIGHTING by a Gas Engineer of eminence—viz., "that little progress had been made in gas engineering or gas-making since its first introduction." By the way, the JOURNAL is a periodical we are all very much indebted to, in ways I need not specify, as most of us have proved its value, and fully appreciate its weekly visit.

With regard to the above statement, I must say I am inclined, to a certain extent, to doubt its sincerity, and call it in question, unless it is an absolute fact that, as the saying is, "there is no new thing under the sun." Of course, as we can say of steam, that great motive agent of ours, that it is to-day made, and its hidden power applied, in the same way as when it was first discovered, so will steam always be formed from water by heat; in the same way will coal gas always be got from coal by the application of heat, just as Murdoch got his first sample of coal spirit, as it was called. But let us look at our gas factories of to-day, and then ask ourselves, Have we made any progress? And I think our answer will be, Yes; great progress.

It is now over 40 years since gas lighting was first introduced into Scotland, and at that time, and for long after, it was, in all its departments, in a very crude state. I can remember the first gas-retort I ever saw, about the year 1835, was a cast-iron one, and that an old tea-kettle. The Engineer and Manager of this primitive gas-works was Mr. John Young, one well known in the gas world, not only for his own abilities, but through his son, one of this Association's most active members, Mr. Young, of Clippens Oil-Works, and his son-in-law, the late Mr. Cusiter, of Dalkeith, one who, in his short day, rendered good service to the chemistry of gas lighting, and who this Association deemed worthy of notice, and whose death, while yet an active worker, we all regret.

The gas made in this primitive retort was the first display of the wonderful "coal spirit" in a town which now boasts of supplying the cheapest and richest gas in Scotland—I refer to Galashiels, a place dear to me as being the home of my youth. Surely, gentlemen, this beginning was small and crude enough, and I would ask, What is it now?

Some of you old men, like myself, may remember the form and kind of retort used in the early days of gas lighting—viz., a cast-iron retort of a ⊃ form, round on the bottom to fit the arch over the furnace. This is now a thing of the past, except in a few very small works, where the consumption is very variable. There are many other forms of retorts, set in all manner of ways, vertical, sloping, and longitudinal, made of cast iron, and latterly of bricks and clay, in one piece and in several pieces—many of the strange combinations, well known to all of us, and to enumerate here, would only be waste of time. Clay retorts are now considered to be the best for obtaining good results, and the makers of clay retorts have not been behind in supplying the demand for this article. The perfection to which their manufacture has been brought speaks much for our forward movements; and of late, by means of machinery, these huge clay vessels can be made in one continuous length while green, thus giving them a uniform consistency when burnt—an advantage none of us can fail to see. We, in Scotland, were the first to use retorts of clay, in consequence of the high heats and short charges necessary in the distillation of cannel coal, which destroyed iron retorts very rapidly unless well protected with fire-clay materials, so making settings very costly, both as regards materials and fuel required to heat the mass of brickwork. Of course, at first, many difficulties had to be overcome; but, after many experiments and failures, we have the clay retort of to-day.

These retorts are of various forms— ⏢ of many sizes and shapes, oval, and circular. For gas-making, the ⏢ or oval are the best, but for strength and durability, the circular prove the most advantageous. At first the retorts were very carefully built in—so carefully, that I can remember when the late Mr. Taylor, of the Edinburgh Gas-Works, then of Kelso, watched and directed every brick and port-hole of some of his first works, and had the iron retort guarded all round with fire-clay lumps in case the strong heat should damage them. The gas made per ton of coals from such retorts must have been small in quantity, but I am inclined to think not deficient in quality, giving some cause for the repeated complaints by consumers, that their gas bills were as small when gas was sold at 12s. per 1000 feet, as they now are when it is half that price. I do not overlook the fact that reduction in price, and a freer use, causes increased consumption, yet I think the complaint is not without cause. Now-a-days we have, instead of one or two retorts in a bed or setting, often as many as ten over

one fire built in with fire-brick in all manner of ways, according to the ideas of the Engineer, and as each of us here, no doubt, has his own plan of setting, it would be useless of me to enumerate any of them, as they are as numerous and various as ourselves. At the same time, each of us has the same end in view—viz., to take gas in quantity out of coals. Suffice it to say, that with us, in Scotland, the most common, and I think best setting for us, is the bed of three retorts. In England, six retorts or seven, in an oven set round one fire, is that most frequently adopted.

Consequent on the use of clay retorts we had high heats, which none of us found fault with, but with them we first knew what choked ascension-pipes were; but even for this evil a remedy has been found in larger ascension-pipes, these at times surrounded by shields or jackets filled with water, front walls of ovens built thicker to protect the pipe from the heat, and the most effectual of all cures found in the inside "grated door;" or, what does equally as well, a plain door, fitting nearly close all round, having a 3-inch opening at the bottom for the gas to pass to the ascension-pipe. This door taken out every charge and cleaned is a cure for "choked ascension-pipes."

I have not mentioned the "Scott and Young" perpendicular retort, nor many others that have been tried with a continuous charging and discharging apparatus, nor the various means patented or in use for charging and drawing, from the shovel and scoop to the West mechanical and the Foulis hydraulic stokers, and others which, in large works, have been successfully used, and in a measure place the manager above dependence on stokers, who, knowing they are of importance in their own line, at times seek to assert it, to the no small annoyance of those whose anxieties are heavy enough already, and which it should be theirs to lighten; and now we managers have the law specially to protect us against desertion in times of anxiety, but this does not even render us safe; though skilled labour is almost a thing of the past where advantage is taken of the improvements above mentioned.

These few facts, I consider, show progress in so far as retorts are concerned; but I cannot leave retorts without noticing the great improvements made on the lids for closing them. This some may think too small an item to notice; yet, in some works, bad lids and lutes are a great source of annoyance and waste. Now-a-days, instead of the heavy cast-iron doors which were often as much as a man could lift (and such weight and strength were considered necessary to keep in the gas and withstand the pressure) we have light wrought-iron lids, weighing only a few pounds, and requiring only a small quantity of luting, and can be put on and removed with ease. Even this is a step in advance; but we have gone further, and have many patent self-sealing lids, some with ground surfaces, and others with a groove filled with asbestos or zinc, and requiring no luting, hung to the retort mouthpiece, and fixed by a patent eccentric fastening. No doubt this will be a great saving of labour and luting, if they can be kept tight, which is very doubtful, from the fact that though these patent doors and fastenings are used largely in England, they have been tried in Scotland and, by some, given up. From the difficulty of keeping a secure gas-joint, these lids and fastenings can only be used to advantage when there is an exhauster.

In Scotland we use the hinged bridle, and when the spent lime from the purifiers is ground up in a mortar mill, and used for luting the lids, the cost will compare very favourably, all things considered, with the lids requiring no luting.

And now, gentlemen, look at the hydraulic main. In its early days we had it small, and of a square form, placed frequently on the retort-house wall in front of the bench, having its outlet for gas and liquor at the end into the tar-cistern, which was placed underground, and requiring daily attention to keep the passage free for gas. This main, from its position, frequently got pitched up, requiring chisels to clear it out. This gave rise to various expedients to cause the tar, which being heaviest, and at the bottom of the main, to flow off first. One plan was a division extending a few inches above and below the water-line, to cause a current at the bottom. Added to this was a box projecting below the main, with the same division inside, so as more effectually to ensure the flow at the bottom. Again, the small cistern, or, as we may call it, "auxiliary main," at the side or end of the hydraulic, connected to the bottom of the latter with a moveable stand-pipe, by which the level of the liquid in the hydraulic main could be regulated so as to have the least possible seal on the dip-pipes. Then the hydraulic main was in one continuous length, causing great difficulties and danger in repairing, which at times was necessary, and where many dips were required, the seal, when few retorts were working, very often became insufficient, and at other times heavy. Many changes and improvements have taken place here in the form of main, position, and also weight, sheet iron now being largely used in place of the huge cast-iron boxes requiring great support. Then we have it cut up into convenient lengths, sometimes one length to every two or four ovens, each distinct, and having valves to regulate the seal and exit for gas, for which purpose our engineers have furnished us with some excellent valves. Many attempts have been made to do away with or supersede the hydraulic main, and not a few clever and ingenious contrivances have been given us—self-acting or otherwise—for either partially or wholly removing the seal from the dip-pipes. Many of us have made trials of such; but none as yet see the advisability of forsaking our old friend the hydraulic, which, when properly adjusted, is, after all, the safest plan; and, it seems to me that no just reason for its removal has or can be given, when we lay against it all the risk, expense, and trouble connected with its substitutes. In hydraulic mains we have various plans for regulating the seal of dip-pipes, and flow of tar from bottom of the main. I may mention among them Wilson's patent, with its contracted and one-side tar chamber, its divisions between each dip-pipe, and its most ingenious but very complicated self-acting "anti-dip reliever."

And now, passing on to the condensing apparatus, which in the early days of gas-making, and even at present, we have a very simple yet effective affair, the gas passing through a series of perpendicular pipes, was cooled, and dropped its cruder matter ere it reached the next stage, and I may say when this condenser is constructed so that the gas can be changed so as to have its entrance and exit from either end, a great amount of cleaning is thereby saved, as the gas when at a certain temperature will keep the pipes clean. Now we have the condenser in many forms, horizontal or vertical. The simplest, and also a very effectual plan, is the wall condenser, which, in many instances, is carried all round the walls of the works, thus saving space, which, in most works, is not over plentiful. We have also the perpendicular pipe condenser, with the internal air-pipes, which gives a large cooling surface to a thin column of gas. The box condenser, with its cross pipes admitting a current of air through them, and the horizontal condenser, built in the form of a screw, so that the liquors formed by condensation are carried along with the current of gas through the whole length of the coil, and, in many cases, a flow of liquor is kept constantly through these pipes, in some cases with the flow of gas, and in others against it. This seems to be a desideratum of condensation—either to be in the open air or immersed in water; and in some cases underground, with a view to carry the condensed liquors as far as possible with the gas, that these might assist in its purification, by taking from the gas further impurities. One gas engineer says, regarding such a condenser: "We regard this as our best condenser. It does its work most effectively." We, however, hear whispered, "As soon as the gas leaves the hydraulic main, separate it from its liquors, or they will rob the gas of its richest particles, giving rich tar and liquor at the risk of impoverishing the gas, and thus be a fair field for the Aitken and Young process, in converting the crude liquor into rich vapour to be picked up, and enrich the gas by that which should never have been out of it." And while here we are learning we have at the same time made progress.

And now we have washers and scrubbers, such as there were in the early days of gas lighting. These two processes are much alike, and at the present day are combined and included in the head of scrubbers. The first form of washer I can remember was a vessel with a raised chamber at one end, having its cover studded with rows of teeth, through which the gas found its way, agitating the water, and forcing it forward to the raised chamber, that it might return again in a succession of ebbs and flows. This was a washer, pure and simple, which I thought had long ago fallen into disuse, as it caused considerable back pressure, but I find it again revived, and being added to a "patent scrubber." In the early days, vessels filled with brushwood of all kinds, boulders, coke, and wooden shelves, were used, but only in small vessels. Now we have many forms of apparatus for scrubbing the gas. The gigantic tower scrubbers, filled with thin boards of wood or coke, with the ingenious motive power for distributing the liquor over the whole scrubbing material, keeping it moist, and displaying large surface for the finely divided streams of gas. Other scrubbers I might mention, but they are all known to you. I may only say it matters little which one or which form we use, if we can get it to do its work thoroughly, by dividing the gas into minute streams, so that if possible every particle of it may come in contact with the scrubbing material, thus robbing it of its impurities; and we may hope to see the day when our ammoniacal liquor, in a certain form, will become our great purifying agent. Already we have taken strides in this direction, and, as a patent scrubbing machine, guaranteed to remove all ammonia, and other scrubbers of small dimensions, with arrangements of perforated iron plates, either washed by a shower of liquor, or revolving on a shaft, and washed in each revolution; thus the gas is very effectually broken up, and, without any increase of back pressure. Then we come to purifiers, where we get rid of the bulk of our impurities—sulphuretted hydrogen, carbonic acid, &c.; and here we can also show progress in no small degree, assisted, no doubt, by the necessity to do something, seeing the removal of the sulphur compounds has caused much trouble and expense, more especially to our brother managers in the south; but, as necessity is the mother of invention, we have had patents and improvements following in quick succession, and yet we have room for more, which, no doubt, will follow, and at last solve the sulphur question. In the matter of purifiers we have made changes in their forms, particularly in their dimensions, also position and working, so as to utilize the purifying material to its utmost, that a saving may be effected. The first attempt at purification, we know, was simply by placing a quantity of lime in the gasholder pit, so that the gas in store might come in contact with it. This was crude enough, but gave us the idea for our first purifier, the wet lime one, which is the most effectual one, however, for the removal of the carbonic acid and sulphuretted hydrogen, but the residues of this process are so offensive, and the motive power required to drive the agitators considerable, that now this form of purifier is of rare occurrence. Then we came to the dry lime process, which is now generally used, and the purifiers for same, and appliances for lifting the covers, which otherwise would be a work of no small difficulty; and valves with which we can control the gas and send it in any direction. In this item alone we have many beautiful appliances which bring our purifier, as far as apparatus is concerned, as near perfection as may be. I remember when purifiers were used without valves, and worked continuous—the first always first, and the last always last; the consequence being that gas-making was stopped when they were being cleaned and filled with fresh lime. When we look back and see the former means of changing the passage of the gas to and from the various purifiers, and shutting it off from those vessels by means of the series of side valves attached to the pipes—a costly, inconvenient, and dangerous plan—and the now simple method by means of the hydraulic valve first, of the many forms of faced valves now in use, we cannot help noticing progress great indeed.

Then of late years oxide of iron has become very generally adopted for the purification of gas, even more so in England than with us; not that the process is superior to that of lime for effectiveness, or I question if in many cases it is on the score of economy; but it entirely overcomes the difficulties where the odour from spent lime is found so objectionable, as it is only necessary to use a small quantity of lime to remove the carbonic acid where the oxide is used, and this lime, when spent, has very little smell, if any. Another great advantage in the use of oxide is that it can be used over and over again, until the sulphur forms nearly 40 per cent. of the mass, and then it can be treated by the chemist, who extracts the sulphur from it for commercial use. Patents have been secured, and, in some works adopted, whereby the oxide can be revivified without removal from the purifiers. Where this is done a great saving is effected, otherwise the labour account incurred in working the oxide is considerable. But we are promised yet another advance in the purification system, and that in the revivifying of spent lime, or, more correctly, the "recalcining of it," whereby it is again rendered fresh for use. This process has been patented, and, I believe, is in use in several works, giving promise of success, and I trust we may hear something of its working to-day from some gentleman who has either seen the process or practically tried it. All this, gentlemen, looks like progress; but we must not stop here, for it has been said by chemists and eminent engineers that the time will come when gas purification will be conducted in closed vessels, and already we have made, and are making, rapid strides in that direction, not only on the side of progress, but profit.

I must now, gentlemen, run over the remainder of this sketch in outline, and allow your minds to fill in and infer therefrom, as I have already taxed your patience.

We have the exhauster and governor, neither of which was in use in the early days. Both are now indispensable in works of any size, and I should say that the latter should never be found wanting, unless, as in some cases, the use of different holders does the work so far satisfactorily. We have many patents, and very clever and serviceable forms of apparatus to choose from; and while we must admit that the exhauster has done much in its own field of labour, yet the governor, in its various forms, has done more, by enabling the Manager to reduce the day pressure to a minimum, and equalize the same at other times, thereby reducing the leakage, and giving more satisfaction to the consumers; and as the tendency and wisdom is now to consume gas at a very low pressure, this can only be accomplished by having large mains and services, accompanied with a like increase on internal fittings of all kinds.

And, gentlemen, when we come to the gasholder we can certainly mark progress, for, by a glance at our large stores of the present day, and those in the early days, when the holders containing a few thousand feet were confined in strong buildings for fear of accident, we, and even the outsiders, have an idea of the advance we have made. And again, looking at the enormous holders now in use, capable of storing not thousands, but millions, and one holder is about being constructed capable of containing

over 3,000,000 feet, this, gentlemen, speaks volumes, and shows the advanced state of the manufacture, to which it appears there is no limit, either in make, distribution, or storeage.

It has been asked, and made a subject for a prize paper, "Can Gasholders be dispensed with, and what can be substituted for them?" An attempt was made on paper to show how this could be, but the building of such large gasholders, as noted, shows that we are far from the realization of such a result.

Should the day come when we are called upon to supply 18-candle gas, instead of 28 or 30 candle as we do now, much alteration will be required in our plant, with larger mains and services. This probability should induce us, as I think we already do, to give up the use of small services and fittings, and, if possible, try and control internal fittings so far as we can, and, at least, we can give our advice, knowing that, to secure a good supply and proper combustion, the pipes to this point cannot be too large, or the pressure, with our many improved burners, too light. I myself do not think that, as far as Scotland is concerned, it is likely such reduction in illuminating power will be necessary, or be desired, as we find consumers in general are prepared to buy light rather than gas, and from this fact we would gather that our work and duty as gas managers is to devise and adopt any and all means that will enrich our present gas from our present materials, and see that our consumers use the burners we know are best suited for its proper combustion, so as to get out of a given quantity the full amount of light profitably, not losing sight of any improvements in the various apparatus, so that the quantity may be increased, and a good and cheap light secured for the public. And I would not say that at present they have anything to complain of. Gas has been sold at 12s. and 16s. per 1000 cubic feet when coals of the first quality could be bought for 18s. per ton; it is now sold at 4s. 6d. and 5s., when the same coal sells at nearly double the former price. This, again, gentlemen, is progress, without doubt.

We have heard of late much about the electric light, and many fears have been expressed as to the probability of its superseding the use of gas, and I believe it has been the means of, in a way, checking the anxiety of corporations to possess the mines of wealth supposed to belong to gas concerns. Certainly science has of late done much for this new means of lighting, but has yet much to do ere we will see the electric lamps by our hearths. There is a large field and ample room for both gas and electricity; the latter can light our lighthouses, large buildings, open spaces, ships, or battle-fields, but much has yet to be done ere we can hope to see any general use made of the lamp, the difficulty being in diffusing such light, or dividing it up into convenient streams to meet the varied requirements of light. Gas possesses this power of distribution, and has added much to the success of our present gas system. One advantage has been claimed for the electric light, and that is the absence of heat. As to this being an advantage, I am doubtful; but it is certainly an item in favour of gas, for if it should ever come to pass that we have to take our stand in the background for light, we can supply heat, do away with much of our troublesome purifying and scrubbing apparatus, and supply a cheap gas for heating and cooking purposes; and by developing the use of gas in this way as we have done in the other, our concerns will still be as successful and profitable, if not more so. But this is a dream; we may realize it, but the time is yet far off; and it would take many years to weaken the hold gas has got as a necessity of life at the present day.

It may be admitted by some (for myself, I do not admit it) that some manufactures have made more progress than gas; but I trust, by these few common-place remarks, that I have shown cause for my obstinacy. Be it as it may, I do not think it is because gas engineers or managers have been remiss in their duty, or behind others in point of intelligence or energy, as can be seen, even from the patent list of past years. We must look somewhere else for the reason. Say, can it be the nature of the subtle element we have to deal with, and work on, and produce? The study and chemistry of gas lighting is a subject more fitted for the university class-room than for the manipulations of a manager who has to perform the duties of engineer, manager, secretary, treasurer, and, in many cases, meter inspector, and collector, with, possibly, the one demand from his employers—viz., "a good dividend." It may be bad managers got more encouragement, and were allowed to reap some of the fruits of their hard labours. In most cases this means a life of incessant toil, sleeping in harness, with the anxiety of long nights and short stores of gas. Only gas managers can know this feeling, when, as it were, the whole population seem to hang on them for support, and they know not of it. This anxiety, and many others, can hardly be paid in money value; and when things take certain turns, and labour is undervalued, can we wonder if energy does lack prominence in some cases? In these days of high wages and short hours, gas managers have not, I think, been found among the agitators, but, as a class, have laboured; and certainly we can every one of us say with all truth we have not "receded."

The subjects to be brought before this meeting, as announced to you by circular, are all of an interesting character, and are as follows, viz.:—

1. "How should the Illuminating Value of Gas be Determined?" By Mr. A. Macpherson, Gas-Works, Kirkcaldy.
2. "The Necessity for a Proper Control over the Pressure of Gas for Illuminating Purposes." By Mr. A. Mitchel, Gas-Works, Dundee.
3. "Governors for Lamps and Stair-lights," with a description of an Improved Metallic Governor, which will be shown in action. By Mr. D. Bruce Peebles, Edinburgh.
4. "A Graduatory Method of Condensing, Washing, and Purifying Coal Gas by a combined System of Rotary Apparatus." By Mr. D. M. Nelson, Glasgow.

In addition to the foregoing papers, the following apparatus is placed on the table for your inspection, viz.:—

One 2-inch Foulis Governor, with Bye-pass arrangement.
One Foulis Patent Automatic Lamp Lighter.
One Foulis Patent Dry Governor.
One Foulis Patent Lamp Regulator.
One Experimental Meter with Warner and Cowan Drum.
One Warner and Cowan Meter with Glass Drum.
Two 20-inch Pressure Gauges.
Three 12-inch Pressure Gauges.
Two Thermometers for Condensers.
One Dry Show Meter.
Two Inspectors Pocket Pressure Gauges in cases.

These apparatus you will examine, and judge of their adaptation for the work they engage to perform; they are not placed there as an advertisement, but for your instruction, and as a further corroboration of the fact that gas-making and gas apparatus have made very great progress.

I cannot, however, close these remarks without adverting to the fact that four of the apparatus now exhibited are patents of Mr. Foulis, of Glasgow, who is a native of St. Andrew's, and whose father was my predecessor as Manager of the gas-works here, previous to his removal to Paisley.

Allow me to say, in conclusion, that St. Andrew's is no mean city. Almost in every land, and in every kind of situation, St. Andrew's boys—by that expression is meant boys who have been educated at St. Andrew's—are to be found holding high and honourable situations in the Church and at the Bar, in the Army and the Navy, in our Civil Service and at St. Stephen's, and not least in the gas world, and to those of you that have sons, and desirous of giving them the best legacy, by a good education, send them to St. Andrew's, where I trust you will all individually receive and carry away with you very pleasing associations.

Mr. M'Crae (Dundee): I think before we proceed to the regular business we must express our gratitude to the President for that very interesting, historical, and practical Address which he has just read. I am sure we all feel refreshed by it. He has given us certain evidence in proof of his closing sentence, that St. Andrew's boys are of some importance. I move a hearty vote of thanks to the President.

Financial Report.

Mr. D. Bruce Peebles gave in the financial report, from which it appeared that the charge was £63 3s. 10½d., and that there was a balance in favour of the Society of £25 19s. 5d. He said: I have merely to remark again that there are a good many in arrears, and I really think that gentlemen who have not paid their subscriptions should pull up, in order that the books may be cleared. I have also to say that there is another species of arrears that we are deplorably at a loss to put right in this Association, and that is that there are a great number of the younger Members of the Association in arrears with papers. I think it is the duty of all members, and more especially young men, to come here with something to say and something to speak about. I should, therefore, strongly impress upon them to take up a subject, no matter what, and say the best they can about it. Something will be sure to come out of such an effort, and those who adopt this course will do themselves good. I know that I have never had more pleasurable sensations that in writing and bringing forward papers for discussion before this Association.

Mr. M'Gilchrist (Dumbarton): If Mr. Robb, of Haddington, is not present, I would propose the motion in reference to arrears which he gave notice of at the last meeting. It is to this effect—that members whose contributions are in arrears for two years, and the same having been intimated to them by circular, the Secretary shall, at the next annual meeting thereafter, be instructed to delete their names from the list of members.

Mr. Fairweather (Barrhead) seconded the motion, which was unanimously adopted.

Rewarding Investigators.

Mr. Hislop (Paisley): The subject which I have the honour to submit to you is one which I have had in my mind for many years, and one which I am sure will meet with your approval. In order to remove any difficulty that may be experienced in rewarding gentlemen who enter into and investigate the several subjects arising in connection with our profession, I move that we ask all the Gas Companies represented in this Association to contribute a small sum annually—perhaps from half-a-guinea in the smaller works to a few pounds in the larger works—to form a fund, to be called the "General Chemical Research and Patents Investigation Fund." Out of this fund, also, prizes may be offered for papers on important subjects. I am certain that no gas company would refuse to contribute a small sum annually towards this fund, and they would look forward towards receiving an equivalent in the way of important information, as the result of these researches, and experimental investigations into patent or other subjects, as they may arise; and, in order to a proper division of labour, I think it might be advisable to form a new committee to take charge of this fund; while, perhaps, if any special subject cropped up, a special committee of gentlemen, who were considered best acquainted with the particular subject, might be appointed at the annual meeting, to investigate and draw up a report on that subject, which report could be submitted to the next annual meeting. Therefore, I submit for your consideration, and, if possible, approval, the formation of a "General Chemical Research, Patents Investigation, and Prize Fund," so that the Association will not, as hitherto, depend upon the liberality of gentlemen coming forward to give sums towards this object.

Mr. Whimster (Perth): I do not exactly see the drift of your meaning. What is to be searched for, and what is the meaning of the search?

Mr. Hislop: I may explain that some learned societies, such as the Chemical Society and the Royal Society, have research funds, from which they award sums for important papers and investigations. If it occurs to this Association that information is wanted in a particular direction, then they offer a sum for research or a prize for the best paper upon this subject, and it will elecit a discussion, and perhaps bring out information which may lead to important results in the management of gas-works. And should any patent be brought under the notice of the Association, the expenses of the Committee appointed by the annual meeting to look into the nature of the patent will be met out of this fund. It is not very likely that gentlemen will expend the time and take the trouble of these investigations without having their expenses paid.

Mr. Fairweather (Barrhead): Would this fund be restricted to Members of the Association, or would it be a general fund?

The President: That is a matter which would be left for the decision of the Association. I think, however, that Mr. Hislop means it for Members of the Association only.

Mr. Hislop: Or it might be otherwise, if deemed advisable.

Mr. Whimster: I cannot say I can get at the object. Is it meant that if any Member of this Association has hit upon a valuable invention, or a discovery of any kind in connection with his profession, that this Committee should undertake to find out whether it was original or not—namely, to search the patent list and ascertain that fact?

Mr. Hislop: It is to inquire into any valuable patent, and report as to its merits or demerits. There are generally so many conflicting statements regarding the value of patents, that it would be desirable to have the opinion of a committee of this Association upon such inventions, conveyed to the whole body.

Mr. M'Crae (Dundee): Like Mr. Whimster, I do not see the purpose of this proposal. I see how money could be got, but I think Mr. Hislop has failed to show a clear application of it. Perhaps it would have been better if he had given us a practical illustration. I will suggest one in the direction which I think he means. Supposing we want to know about how Mr. Hislop's process for the recalcination of lime is proceeding, and we appoint a committee for this purpose, are we to understand that this money is to be applied to meet the expenses of the Committee? If that is what is meant by research, then we can see the point. I merely quote the case of Mr. Hislop as an illustration, of course. If I am correct in my supposition, the inquiry will be with regard to all patents before us, and if this is so, perhaps I shall have something further to say.

Mr. Hislop: Well, we have here Mr. Peebles's patent before us to-day, and it in the interest of all gas companies to know its value immediately, and I think, taking this as an instance, if this Committee were appointed to give in a report, their statement would serve for all the companies contributing to the fund. I hold that if a committee of those best qualified to judge of the particular thing were to be appointed to examine carefully and report upon the value of the invention, the Association would be ready to accept the decision of that Committee as representing something like the true value of this invention or patent. In this I do not mean to refer to all patent improvements of processes that may appear. As I have already said, I have had it in my mind for many years to bring this question before

the Association; and I do it now in order that the *pros* and *cons* may be discussed.

Mr. M'Gilchrist (Dumbarton), in seconding the motion, said: Any one looking at the subject will see the necessity for the establishment of such a fund. Even Mr. Hislop's process would be none the worse for being investigated, and perhaps the whole Association, and the gas world generally, will be much benefited by the labours of any committee appointed for such a purpose by the Association.

Mr. M'Crae: I move, as an amendment, that this Association take no steps to raise funds, by asking either companies or corporations to contribute for such a purpose. I am sure that there are no gas companies or corporations in Scotland, if their engineers or managers wished to investigate a particular process, but would gladly contribute the necessary funds to send these gentlemen to the place where the process was to be seen in operation; and who is more capable of judging of what is applicable for his own individual purpose, and his own particular requirements, than the engineer, manager, and perhaps chairman, or other intelligent member of the company? Are we to be expected to hand over our judgment as to the suitableness of this, that, or the other patent, which might be good in some respects, to a committee named promiscuously by this meeting, and are we to be expected to abide by their decision, and say that this is good or bad, as the case may be? I move that we, as an Association, make no attempt to raise funds from our companies or corporations for such a purpose.

Mr. Whimster: I second the amendment. I cannot see the force of an Association like this getting up funds to supplement the Patent Office in its affairs. That office takes money from patentees, and nothing is given in return, except when the patents prove to be original. They will not search. They will not tell whether this or the other invention placed before them to be patented had not been patented on the previous day. We have no means of ascertaining that, and I could see the common sense of getting up a fund to seach the patent records, to tell any member of this Association whether his patent was an old thing, or really a new thing. It would save him a great deal of anxiety, and a great deal of money. I think that if any new invention is worth it, it will be found out sooner or later. For instance, we have a Committee, and if they see anything of real importance to this Association, they might appoint one or two of their number to investigate the invention. These gentlemen could do all that is necessary, and their expenses would be paid. Thus we have the machinery, which might reach the object Mr. Hislop has in view.

Mr. M'Gilchrist: When would Mr. Whimster have the patent lists examined?

Mr. Whimster: Before the invention was patented, in order to save expense.

Mr. M'Gilchrist: If a gas engineer had any good ideas, perhaps he would find that they were patented before he could get the money for his paid.

Mr. Whimster: There is a slight mistake on Mr. M'Gilchrist's part. The patentee would understand that we are gentlemen, and any patent communicated to the Committee would be kept secret. My object is this: If a member of this Association thinks he has made a valuable discovery, he applies to the Committee, and they search the patent records to see whether the thing is new or old.

The President: Do not you think in this way that the Committee would just be doing the inventor's work, and it is doubtful whether the Association would reap any benefit from it? It would be the individua alone.

Mr. Whimster: As a member of the Association.

Mr. Hislop: Is it to be expected that every patent before the Association would be the subject of inquiry? It would only be when the Committee heard of something that was novel, and was likely to benefit the gas world generally, that the subject would be investigated—certainly not everything that might happen to be brought before the Association.

The President: I think that in his statement now to the Association Mr. Hislop has gone beyond the idea I had, from what he told me this morning. I will state what was my idea of the fund. We all know how difficult it is to get papers from the younger members, and it is almost equally difficult to get them from the older members. I thought that if the young and other members of the Association were to prepare papers, the Committee might adjudicate upon them, and award a small sum, as they might think fit, for their excellence.

Mr. Hislop: That is undoubtedly part of my motion. It is well known that the Association has not the means to meet these demands. If we were to ask a simple contribution from gas companies for this object, I do not know of any one who would grudge it.

The President: I think there would be no difficulty in getting up a small fund to assist us in this object. It would be a pity if we were to differ on the distribution of the fund.

Mr. M'Crae: You have introduced a new element into this motion. It is now limited apparently to the matter of awards for papers by the younger members. But supposing you do limit it, with all the earnestness which I possess, I object to members giving money awards for papers. We have now been prize-paying for the last ten years, and what is the result to-day? Have the awards which have been held out been successful in bringing out papers? In thus offering prizes, I do not think you dignify our young men; you will keep proper-minded and intelligent young men from writing papers, just because there is something of a pecuniary reward held out to view. Let honour and elevation in their profession be the only reward which this Association attaches to a paper, and I guarantee you will bring out more papers, and of higher quality, than by the offer of money. It is altogether a mistake to hold out the temptation of £5, £10, or any number of pounds to young men, with the expectation that that will produce a paper on the profession in which they are, or expect to be, engaged.

Mr. M'Gilchrist: Mr. M'Crae is certainly wrong when he says that this motion has been limited in any way, because, although I had not known of the motion until it was proposed to-day, the part referred to was certainly intended as part of the motion, in my opinion. I think he is also mistaken in saying that these money prizes have produced nothing in ten years. I think they have produced first-rate results. The papers by Mr. Innes, late of Forfar, and Mr. Macpherson, of Kirkcaldy, are excellent specimens of what those awards have done.

Mr. M'Crae: I said look at the results. I did not say that they had produced nothing.

The President: I did not mean by my remarks to place my opinion either for or against the motion. I merely stated what my impression was when Mr. Hislop mentioned his motion to me. I see my way, so far as regards the lesser proposal, to adopt it. I will now put the motion and the amendment to the meeting.

On a vote being taken, 14 voted for the amendment, and 16 for the motion.

The President: The Association is so closely divided that I think it would be advisable to remit the matter to the Committee to bring up a report to the next annual meeting.

This was agreed to.

Election of Office-Bearers.

The President: I have to report that the Scrutineers have examined the ballot papers, and the following is the list of members chosen for the ensuing year:—

President.—Mr. Alexander Smith, Aberdeen.

Vice-Presidents.—Mr. Peter Watson, Stirling; and Mr. James Robb, Haddington.

Secretary.—Mr. W. Mackenzie, Dunfermline.

New Members of Committee.—Mr. John Reid, Leith; Mr. James M'Gilchrist, Dumbarton; and Mr. George T. Myers, Broughty Ferry.

The Auditor, Mr. D. Bruce Peebles, was re-appointed; and the next annual meeting of the Association was fixed to take place in Edinburgh, on the second Thursday of July, 1879, and following day.

Mr. Whimster: If this is the proper time, I have a suggestion to make regarding the election of officials. We have had this year the opportunity, not only of selecting Members of Committee, but of choosing the town in which we are to meet; but we have no choice as regards a President and Vice-Presidents. I would only suggest whether it would not be well for the Committee to give the Members of the Association a choice in their election also. The Committee name certain gentlemen who are sure to be elected.

The Secretary: Any one is at liberty to erase the names on the paper, and substitute whoever he thinks proper.

Mr. Whimster: That does not meet the case. It would be better for the Committee to select two gentlemen in the one case and four in the other, and give the Members a choice.

Mr. James Whimster: Some of the Members voting to-day have gone from the beaten track, and put in the names of gentlemen more suitable in their view; but still, if a list of names is printed, people will say, "Well, we will just accept the list."

Mr. Macpherson: I think the paper sent out by the Committee should rule our selection, because there are no persons better qualified than the Committee to select fit and worthy representatives of the Association on the Committee. I think the objection is quite met by the direction printed at the foot of the circular, to the effect that members are to erase any name, and substitute any other they may think proper.

The President: If the Association had the choice, it would relieve the Committee of a very disagreeable duty sometimes.

Mr. M'Gilchrist: The Committees in the past have deserved thanks for selecting good Presidents, and I think they have established a claim to elect for the future.

Mr. M'Crae: With all deference to Mr. Whimster, I think we have an opportunity of putting any member in for President, but I think, from the fact that the nominees of the Committee have always been elected by the ballot of the members, is evidence that the Committee have done right.

The President: Does Mr. Whimster wish to propose a resolution?

Mr. Whimster: No; I just wished to direct the notice of the Association to the question.

Mr. Macpherson (Kirkcaldy) read the first paper, entitled,

HOW SHOULD THE VALUE OF GAS BE DETERMINED?

On a former occasion I had the honour of bringing before you in a paper the subject of "The Relations which exist beween the Durability and Bromine Tests and the Illuminating Power of Gas as expressed in Standard Candles," and at that time I endeavoured to show you that these relations were definite and marked, and that, with careful manipulation, the three methods then spoken of—viz., the illuminating power as ascertained by the photometer, the durability test, and the absorption of the hydrocarbons by bromine, could all be made to check and corroborate each other. And notwithstanding an occasional dissentient has been heard, I am still of opinion that the tables I then laid before you will be found a pretty accurate and safe guide in determining the value of gas, and I am pleased to think that a very considerable number of my professional brethren have shown their faith in these by having almost entirely discarded the photometer for the—in my opinion, as accurate and more simple method—durablity test, with, I understand, very satisfactory results.

What I wish briefly to draw your attention to to-day is the very important question, "How should the value of gas be determined?" My intention at this time is not to attempt to instruct any one, but rather, by a few remarks, to provoke a discussion, and elicit the views of the members thereon, as it is of importance that a very decided opinion should be given by this and all kindred Associations on this point.

It is a well-known and admitted fact, that the lighting properties of a gas, or mixture of gases, must depend on the relation which the carbon in it bears to the hydrogen, always, of course, provided that no destructive or injurious ingredient, such as carbonic acid, is present. If we look at the different constituents which go to make up that very complex body, coal gas, we at once become convinced that it is on the hydrocarbons therein we must depend for illumination.

Hydrogen, which is present in considerable quantity, when ignited burns with a pale and almost invisible flame, and is non-luminous; but if we ignite light carbide of hydrogen, or, as it is often termed marsh gas, which is hydrogen in combination with one equivalent of carbon, we obtain a flame rather stronger than hydrogen, and slightly luminous, and as we go on increasing the proportion of carbon, we find the luminosity also increases and likewise the specific gravity and the durability, as also the height of the flame under a fixed pressure, which shows that these are all controlled by the proportion of carbon present in the mixture.

The value of coal gas, therefore, as supplied to the consumer, will be as the light yielded by, and the durability of, a given quantity. The method at present fixed by the Legislature for determining its value is, I need not say, by the photometer, a system of comparison with another source or unit of light; but why, I ask, should this be so? and why practise such a system, which is open to so many and grave errors, and which requires so much care in manipulation, when we have wherewith in itself, without the tedium and risk of error by comparison, a source whereby we can determine the value thereof to the consumer? I mean the durability of a given quantity—a system by which the most inexperienced person, who is provided with the necessary apparatus, may, with very little practice, be able to determine correctly the value to him of the gas supplied for his use, and by which managers may, by the observation of a single minute, satisfy themselves of the quality of the gas they are sending out to their consumers. By the present photometric system, I am certain errors of considerable magnitude are often committed. There are so many details to attend to, and, I make bold to say, no two operators using the same gas will declare it to be of the same illuminating power, and this arises from causes over which they have no control. Besides, can any one guarantee that all the candles used, as the unit of comparison by different operators, are identically of the same illuminating power? You may well, with a delicate and accurate balance, consume the prescribed 120 grains of sperm per hour, or rather ascertain thereby the exact number of grains consumed; but, can any one say he will guarantee that the consumption of, say another 120 grains of the same, or another

candle, will yield the same amount of illumination as the 120 grains formerly consumed? And, as we have no control over the consumption of sperm per hour, but must simply note the quantity consumed, and work out the corrected result in the approved manner, may not error also be here introduced? We know that with gas there is a certain rate at which, if we wish to obtain the greatest amount of illuminating value, we must consume it, and that, beyond or below that rate, the greatest possible amount of illumination will not be obtained; but only an approximate—a very near one, it may be, but still only an approximate. Is it not possible that, by consuming, say, 130 grains, or 110 grains, of sperm per hour, instead of the prescribed 120 grains, that the illuminating power of the 130 grains, or 110 grains, was greater or less in proportion than the amount that would have been yielded by the exact 120 grains?

Another way in which error may be introduced into a photometric test is in selecting an improper or unsuitable burner. It is of great importance, in determining the illuminating power of gases, that the burner used for this purpose should be one suitable for the consumption of the particular quality of gas under examination, otherwise we cannot hope to arrive at a just and true estimate of its value; and if the same burner is used for determining the value of a gas which is of, say, 30-candle power as for one of, say, 20-candle power, very considerable error will be the result. The pressure at which the gas is consumed also exercises considerable control on the results obtained. It has been clearly demonstrated, and is now accepted as an undoubted fact, that, to obtain the greatest amount of illumination out of gas, it requires to be consumed by a burner suited for a particular quality, and also at a pressure which will permit of the suspension of the carbon for such a length of time in the flame as will ensure its thorough combustion, and not its mere passage through the burner. Now, how are we all to arrive at these particulars with sufficient accuracy to enable us to say we have obtained the full, true, and accurate value of any gas which we may be examining? And, although, no doubt, careful operators will endeavour to do full justice to all their tests, by taking into consideration these and many other very material details, are the convictions of all operators alike regarding the kind and size of burners, and the most suitable pressures for the consumption of the different qualities of gas which come under their hands for examination? Truly we may say that such is not the case; for how often do we witness very great disparity between the results obtained by different operators when testing the quality of the gas supplied to towns; and also in the published analyses of coal, when the same coal may have been tested by two or three different analysts, we not unfrequently find a wide diversity of results; and how are we to account for this diversity, when we find the analysts to be all good and experienced men, and well qualified to conduct the experiments? We cannot attribute it to carelessness or indifference on their part, but rather, I am inclined to think, to the different ideas each may possess on material and important points of detail, and the different conditions under which they may be working.

But now let us turn our attention to the method of estimating the value of a gas by its durability, which is a point of great importance to the consumer. I have before said that by this method we do not require to employ another source of light as a means of comparison; for if I am right in my contention, that the photogenic power and the durability of a gas are both controlled by the amount of carbon therein, and that these bear a direct and definite relation to each other, and that according to the durability, so will the photogenic power be, and *vice versâ*, according to the photogenic power so will the durability of any gas be, as both are dependent on the carbon present, and that, according as the proportion of this increases or decreases, so in a like manner, and in a relative degree, will the illuminating power and the durability increase or decrease. Consequently, if the durability is determined, we have a correct and just estimate of the commercial and illuminating value of gas, and from this also can be ascertained, if it is necessary that it should be so stated, the illuminating power in standard candles; but I see no reason for this latter. I consider that to any practical man the statement of the durability of a gas will convey to his mind as true an estimate of its value as if he was told it was of so many candles power. By this method of determining the value we are freed from all chance of error consequent on having a unit or source of comparison, as the gas contains in itself all that is requisite for fixing its value, and the method of determining this is so exceedingly simple, and so well known to all of you here present, that I need scarcely occupy your time in describing it; however, it may be as well to refer to it briefly. By this process, as in the photometric, we require an accurate experimental meter, a platinum tipped jet, with a single orifice of a fixed diameter, and a graduated scale, the zero line of which is fixed exactly level with the top of the jet. All that you now require to do is to regulate the height of the flame issuing from the orifice in the jet to, say, 5 inches, as marked on the scale, and, with a watch or minute clock, to note how many minutes are required for the consumption of one cubic foot of gas. The facilities for error are here reduced to the minimum, and with ordinary care operators should be able to arrive at identical results. But some may say, "We find, with the utmost care, that we obtain results so conflicting that when we compare them it is impossible to place reliance on the durability test." I acknowledge that conflicting results are often obtained, but why should we so perversely attach the blame to the test in which the facility for error is reduced to the minimum, when compared with the facilities for error in the other? Besides, no one will deny that in determining the value of a gas to the consumer, durability forms an essential point, and if there is no relation between the durability and the illuminating power, then it is impossible to determine the commercial value by a mere statement of the candle power, unless the durability be at the same time given. For instance, let us suppose this city to be supplied with a gas of 28-candle power, and the durability of one cubic foot, by a 5-inch flame, to be 59 minutes, and another city or town to be supplied with a gas of 28-candle power, but with a durability of, say, only 54 minutes, and that both places are charged at the same rate per 1000 feet, we have thus the same candle power and the same price; but will any one say they are of equal value. But this I maintain cannot be, and that the apparent disparity is due, not to any difference in the quality or value of the two gases, but solely to error committed in one or other of the experiments.

I have no doubt a fruitful source of error is to be found in the provision by which photometric tests are hampered, and rendered unjust, by compelling the operator to correct the results of his experiment to the standard temperature and pressure, by which provision gas companies are, in my opinion, subjected to unfair treatment. What could be more fair and equable than that 5 cubic feet of gas, as measured at the time it is being supplied for consumption, should be so considered? But no such quantity is to be considered 5 cubic feet unless we are under the comfortable condition of 60° Fahr. and 30 inches of barometric pressure. And this is a circumstance to which a good deal of blame may be attached for the apparent disparity of the results obtained by the two different tests referred to, for while I find nearly all analysts strictly comply with this provision in making the photometric test, some do not make any correction when determining the durability, and I need not say equal results cannot thus be obtained; and any attempt made to trace the relations between illuminating power and durability in such instances can only end in failure, or, if found, they are the result of a mere accidental coincidence of circumstances. But why should there be any such fixed standard of temperature and pressure? Why not accept the quantity as recorded by the meter as used at the time of the experiment as the correct measure, either for a photometric or durability test? The consumer cannot be made to pay for any quantity but that recorded on the meter, and which quantity is influenced by the ever-changing conditions of our climate in the same manner as the quantity used for test purposes; but no attempt, if such was possible, has been made to correct this to the standard temperature and pressure, and to charge the consumer accordingly. Then, if the consumer is to pay for, say, 100 or 1000 feet, as measured by the meter at the time of consumption, let the 5 feet, or whatevar quantity is used during a test, be considered and treated as that quantity for this purpose also (of course, in this I except comparative analysis); otherwise a gross injustice, in my opinion, is perpetrated on gas companies. What, I wonder, would any of our coalmaster friends think of an invoice returned to them thus corrected: Deduct so and so from weight, as the coal was very wet from rain when received, consequently, although we got weight, some portion of it must be considered as rain absorbed by the coal? I have no hesitation in saying we would get the invoice returned, without any deduction, as correct, with an intimation that they could not help the weather being rainy, and that they sold their coals by the weight as ascertained at the time of despatch, irrespective of the state of the atmosphere. Then, I say, let us do the same, and sell our gas by measure, as ascertained at the period of consumption, irrespective of the state of the atmosphere, and insist on the quantity used for test purposes being treated in the same manner.

I have heard it stated that some samples of coal gas contain vapours of very high illuminating power, which increase the illuminating power to a very great extent, but that they do not exercise a like influence on the durability, which does not respond in the same manner to their presence, as they do not in the same proportion increase the durability as they do the illuminating power, and thus their presence cannot, as it were, be detected by the durability test. Really these must be subtile vapours indeed, and what can they be composed of? I take it they can only be of the hydrocarbon class—of the richer class, it may be; but rest assured, if such vapours are present in any gas to such an extent as to increase its illuminating power, or to any extent whatever, they will exercise a like influence, and in the same proportionate degree, on the durability. Do not allow any such specious reasoning as that to influence your judgment on such an important matter, because the same law which regulates the value of a gas for illuminating purposes—viz., the proportion of carbon present—will fix and establish its illuminating power, and also its durability, and these will bear a definite and direct relation to each other. I would, therefore, strongly recommend to all, for practical and experimental purposes, the use of the durability test as the one on which most reliance can be placed, as it offers few opportunities for error, is simple, and easily accomplished.

The discussion which followed the reading of the above paper will be given in the next JOURNAL.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 134.)

WEDNESDAY, JUNE 19.

Mr. F. LIVESEY read the following paper on

SOME EXPERIMENTS WITH AMMONIACAL LIQUOR AS A PURIFYING AGENT.

In working out the experiments of which this paper is a description, I have felt that the subject is not in sufficiently competent hands to give the question the thorough investigation it deserves. It should properly be dealt with by a gas-maker who is also a clever chemist. I hope, however, the experiments I shall bring before you may be of use, and that, perhaps, they may lead to some useful results.

It has often been expressed that the purification of gas will ultimately be accomplished in closed vessels, by means of the ammonia produced in the carbonization of the coal, and many attempts have been made in this direction without much success.

There is, however, this satisfaction, that all attempts made bring some further knowledge to bear on the subject, and so help on this much-to-be-desired object. One chief obstacle in the way to this end is that the quantity of ammonia produced is only sufficient to purify about one-sixth part of the gas, so it seems necessary to use the ammoniacal liquor some six times over, being subjected to a purifying process after each succesive operation.

Lime, if used in a proper manner, will purify gas from sulphuretted hydrogen (H_2S), carbonic acid (CO_2), and the greater portion of the sulphur compounds, and as there are many points in common in the chemical affinities of lime and ammonia, it is only to be expected that ammonia would do similar work to lime.

To remove the sulphur compounds, lime must be in the form of sulphide, and the gas must be free from CO_2. These conditions were formerly considered sufficient; it is now, however, certain that H_2S in any appreciable quantity interferes materially with the power of the sulphide of calcium to absorb the sulphur compounds.

Now, there is little difficulty in taking out the H_2S and CO_2 by means of the ammonia present, if in sufficient quantities; but to take out the CS_2 becomes the difficulty, for a foul liquor must be applied to a comparatively clean gas, thus making the gas once more foul by taking up H_2S and NH_3 from the liquor, and so rendering purifiers and scrubbers again necessary.

Lime, when carbonated, is of no use for taking out the sulphur compounds, and it is the same with foul ammoniacal liquor, which is generally half carbonated when applied. A sulphide of ammonium is a difficult liquor to produce in ordinary gas-making, and, when made, difficult to apply, for the reason I have mentioned before, and also because it so readily gives up its ammonia to a clean gas. Where one impurity can be driven forward from foul lime—viz. (H_2S), by CO_2; from foul liquor the gas will carry forward three—H_2S, CO_2, and NH_3.

These reasons seem to me the cause why ammonia has not yet effected the entire purification of gas.

That ammonia will, and does, accomplish much in the purification is well known, and these experiments have been made with a view to get the greatest amount of good out of it.

If sulphide of calcium is exposed to the action of gas containing CO_2, it will ultimately become more carbonated as the contact is continued, and with ammoniacal liquor it is much the same, thus leading to the conclusion that by long contact with the gas, a greater proportion of CO_2 will be removed, while with a short contact and a weak liquor HS_2 will chiefly be taken out. Taking into consideration that the gas liquor is used in the earliest stages of purification, it is unquestionably better to get rid of the CO_2 by its means than by lime, and it seems better to work the liquor with that object in view. No plan, I believe, of working gas liquor will take out the CO_2 so effectively as a purified liquor, or certainly not in sufficient quantities to do away with the necessity for CO_2 boxes.

It will be found that every ounce strength of ammonia in gas liquor equals 0·347 oz. of absolute ammonia, which will combine with 416 cubic

inches of H_2S to form sulphide of ammonium, $(NH_4)_2S$, or with 414 cubic inches of CO_2 to form carbonate of ammonium, $(NH_4)_2CO_3$; so that every ounce strength of NH_3 in the liquor should show, if entirely combined, some 416 cubic inches of impurities.

TABLE No. 1.

Description of Liquor.	Cubic Inches of Impurities per Gallon.			Cubic In. of Impurities per Ounce of Strength.	Ounces of (distilled) NH_3.	Ounces of NH_3 Acid Test.
	H_2S.	CO_2.	Total.			
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
1. From Livesey's scrubber washer, supplied with water	4339	1972	6311	394	—	16
2. Ditto, ditto	3967	595	4562	456	—	10
3. Livesey's washer liquor	2200	7158	9358	426	—	22
4. Ditto ditto	1983	9982	11965	443	—	27
5. Ditto ditto	1952	1176	3128	368	8½	8½
6. Ditto ditto	2200	1313	3513	379	9¼	8
7. Mann and Walker's scrubber (small size)	1611	8606	10217	537	—	19
8. Ditto ditto (large size)	1301	13984	15285	436	—	35
9. Ditto ditto, ditto	1890	5574	7464	439	—	17
10. Condenser	1115	1233	2348	313	7½	6½
11. Ditto	1363	1159	2522	325	7¾	6½
12. Hydraulic main	464	308	772	154	5	3
13. Ditto	433	457	890	162	5½	3
14. Purified liquor	434	247	681	113	—	6
15. Liquor before purification	2076	3088	5164	368	14	—
16. Same liquor after purification	620	1233	1853	132	14	—
17. Liquor before purification	2076	2002	4078	370	11	10
18. Same liquor after purification	867	489	1356	123	11	10
19. Experiment to saturate a 9½ oz. liquor, foul gas passing into it, ammonia kept back by acid	867	2907	3774	397	9¼	—
20. Experiment to saturate a pure ammonia solution with H_2S	3533	—	3533	430	8 1-5th	8 1-5th

Table No. 1 gives an analysis of gas liquors from the different condensing and purifying apparatus. Column No. 1 shows the number of cubic inches of H_2S per gallon; No. 2, the number of cubic inches of CO_2; No. 3, the total number of cubic inches of impurities; No. 4, the total number of cubic inches of impurities per ounce of strength; No. 5, the strength of ammonia.

Take the hydraulic main liquor (No. 12). This contains only 154 cubic inches of impurities per ounce, instead of 416; another analysis (No. 13) of hydraulic main liquor, 162. Condenser liquor contains more, but still much short of the standard. Two different samples (Nos. 10 and 11) give 313 and 325, whereas an analysis of washer liquor (No. 6) in one case gives 379.

It will be noticed that several are over the standard of 416—the one from a Mann and Walker's scrubber (No. 7) showing as much as 537; but this may be caused by there being no distillation test for this sample. I have little doubt, had such been the case, the figures would have been much reduced. Where the liquor has been distilled for the ammonia strength, the result is taken as the divisor; and it will be noticed that, under these circumstances, they never reach higher than 379 (Nos. 6 and 16).

Hills's purified liquor (No. 18) is about as pure as the hydraulic main liquor, containing only 132 cubic inches of impurities per ounce. Another analysis (No. 18) gives only 123 per ounce, the same liquor having contained before 370. The hydraulic main liquor is always weak in impurities, from, I suppose, the same reason that enables Mr. Hills to purify gas liquor—namely, by heating it to something below boiling point, and so driving off the H_2S and CO_2. The temperature of the liquor in the hydraulic must be sufficient to prevent the combination of these impurities, and so leave them to be carried on with the gas till the temperature is reduced.

TABLE No. 2.

Ammoniacal Liquor, How Used.	Cubic Inches of Impurities removed per 1000 Cubic Feet of Gas.			Cubic Inches of Impurities removed per 1000 Cubic Feet of Gas per Ounce of Increased Strength.	Gallons of Liquor used per 1000 Cub. Feet of Gas.	Increase in Ammonia Strength.	
	H_2S.	CO_2.	Total.			Acid Test. Ounces.	Distilled. Ounces.
	No. 1	No. 2	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
1. Livesey's large washer, foul gas entering	720	994	1714	487	1·01	3½ viz., 7 -10½	—
2. Ditto ditto	5688	3574	9262	1684	4·37	5½ ,, 7½-13	—
3. Ditto ditto	8673	2122	10797	5398	8·4	2 ,, 6 - 8	1½
4. Livesey's foul gas entering, water used	1747	1429	3176	317	·75	10 ,, 0 -10	—
5. Livesey's large washer; liquor left in washer 42 hours, foul gas entering	347	3723	3070	175	·45	17½ ,, 7½-25	16½
6. Livesey's scrubber washer, entering as water	2892	1315	4207	262	·66	16 ,, 0 -16	—
7. Mann and Walker's scrubber, entering as water	1007	5379	6386	336	·62	19 ,, 0 -19	23½
8. Ditto ditto	1039	3067	4106	241	·55	17 ,, 0 -17	—
9. Livesey's washer, entering as Hills's purified liquor, gas having previously passed one washer	1139	1414	2553	2553	·69	1 ,, 12 -13	—
10. Ditto ditto	745	1426	2171	931	·71	2½ ,, 13 -15½	3
11. Ditto ditto	1999	3804	5803	4363	1·56	1½ ,, 10 -11½	2
12. Ditto ditto	1236	1466	2702	1·4	1	,, 5 - 6	½ (6—6½)
13. Hills's purified liquor, foul gas entering	5097	2228	7325	3662	2·9	2 ,, 6 - 8	—
14. Ditto ditto	4099	2683	6782	1937	2·1	3½ ,, 5 - 8½	3½ (6—9½)
15. Anderson's washer, conditions not known	1858	1378	3236	588	1·83	5½ ,, 0 - 5½	—
16. Scrubber liquor entering as water, gas not foul	505	409	914	294	·52	3½ ,, 0 - 3½	—

N.B.—By foul gas is meant gas coming from condenser.

Table No. 2 is for the purpose of showing the work done by the liquor in passing through either washer or scrubber, as the case may be. The first column shows cubic inches of H_2S removed per 1000 cubic feet of gas; the second column, the amount of CO_2; and the third column, the two combined. The fourth column, which shows the work done, gives the cubic inches of impurities removed per 1000 feet of gas for every ounce of strength the liquor increases in passing through the vessel. The next column shows the quantity of liquor used per 1000 feet of gas, and the last two columns show the ammonia strength.

In estimating the amount of work done by any liquor, the state of the gas must be taken into account; for, if the gas is comparatively clean, the liquor will not do so much work. It will be noticed that the best results, in regard to removing the greatest quantity of impurities, are gained by the use of an excessive quantity of liquor. In experiment No. 3 in the table, as much as 10,797 cubic inches of impurities were removed per 1000 feet of gas; but, to obtain this effect, 8·4 gallons of liquor were used for the same quantity of gas, being about three times the total quantity of liquor produced from that gas. I, however, judge from this and other experiments, that, by the use of a large quantity of liquor, H_2S will be most easily removed; a longer contact being required for the combination of CO_2.

Experiment No. 5 shows this: A washer was filled with liquor, being equal to about half a gallon to every 1000 feet of gas passed through. The same liquor was left in the washer 24 hours. The liquor in this case removed more CO_2 than in the previously mentioned experiment. The gas being, in both cases, in the same state of foulness. If, therefore, you could leave gas liquor in a washer without increasing its strength, it would ultimately become carbonated to somewhat the same extent as a lime purifier.

The hydraulic main liquor contains, as other analyses have shown, the largest proportion of fixed salt; the condenser liquor, the next largest proportion; and the scrubber and washer liquor, least. Here are a few examples:—

	Acid Test. Oz.		Distilled.		Twaddel Doubled.
Hydraulic main liquor	3	..	5½	..	4½
Condenser ,,	6½	..	7½	..	3½
Do. ,,	6½	..	7½	..	4½
Mann and Walker's scrubber	19	..	23½	..	21
Livesey's scrubber-washer liquor.	11	..	13½	..	2½
Ditto ,, ,,	13	..	—	..	6
Hills's purified liquor	5	..	6	..	0
Do. ,,	6	..	—	..	1
Do. ,,	10	..	11	..	2¾

The last column shows most conclusively that Twaddel's hydrometer is of no use for indicating the strength, and more especially will the discrepancy be noticed with purified liquor, the first on the list of that class showing a 6-oz. liquor to have no strength, this particular liquor containing little or no CO_2.

My conclusions as to the best way of working gas liquor are as follows:—Should it be required to make the best use of the liquor, in the ordinary way of working, one point certainly to be remembered is to pass the condenser liquor through some efficient washer or scrubber, as this liquor has not generally above two-thirds its proper quantity of impurities. Analyze the liquor, to see if it contains its proper complement for its strength, and if it does, there is little use in working it over and over again, unless it is convenient to concentrate it for purposes of carriage.

To use the liquor for the removal chiefly of CO_2 seems to be rather a difficulty, for by keeping it in long contact with the gas, though more CO_2 is removed, less purifying work is done.

The best purifying results, however, both as to H_2S and CO_2, are obtained by bringing the gas produced from a certain quantity of coals into contact with from three to six times the quantity of liquor produced from the same quantity of coals, and at the same time subjecting the liquor to a continuous purifying process; or, in other words, the great thing desired is more ammonia. This, of course, means a large liquor purifying power, which is, however, in most cases, easy of adoption. Whether the purification of the gas will be improved by concentrating or distilling the ammonia is still an open question, for, when strong ammonia is used, that impurity is so readily carried forward. To use gas liquor for the removal of the sulphur compounds seems to be a very difficult matter, for these reasons—The gas must be comparatively pure from CO_2, H_2S, and NH_3; the first two gases because the ammonia will not react upon the sulphur compounds in their presence, and the latter must be removed in taking out the two former. So that here is the gas, once purified, to be made quite foul again, and so render necessary a duplication of all purifying apparatus.

The mere record of experiments in the form of tables is not an interesting subject to read a paper about, and I must, therefore, ask for your indulgence if it has proved somewhat tedious. If this has been the case, it is not the fault of the subject, which is both useful and interesting, but of the writer, who is anxious to have his conclusions sifted by your criticisms.

Mr. HUNT said the members were much indebted to Mr. Marshall and Mr. Livesey for their papers. The subject of liquid purification was one of immense interest to gas manufacturers, and any information given with regard to it ought to be well discussed. With reference to Mr. Marshall's paper and the Hills decarbonating process, as practised by Mr. Livesey, he hardly understood the conclusions at which he had arrived. He stated that the liquor, after having been treated as Mr. Livesey did, contained very little free ammonia, and that was hardly consistent with the fact that the ammonia so treated took up a certain amount of sulphuretted hydrogen, and also that there was such a proportion of sulphuretted hydrogen and carbonic acid liberated. So far as he had been able to study the subject, Mr. Hills's process offered, for the present, the most practical solution of the question. With reference to the process patented by Messrs. Wallace and Claus, the figures Mr. Marshall had presented were certainly very tempting, and ought to induce them to give great attention to it; but in order to arrive at those satisfactory results, the ammonia sulphur process being such a success as had been stated, they were asked to introduce into gas-works an entirely new chemical process, which required really separate treatment and separate management. The difficulty was not with regard to the treatment of the carbonic acid and the sulphuretted hydrogen, it was to obtain the source of fresh ammonia. There was nothing really new in Messrs. Wallace and Claus's process with regard to the scrubbing, but simply with regard to the supply of ammonia, and there was the difficulty. If they could show that their process was practicably workable and profitable, he had no doubt it would be speedily adopted.

Mr. GORE said Mr. Hunt had touched on an important question in connection with the application of liquids to purify gas, and had asked a question which he could answer—namely, how were they to provide the ammonia in the form in which it should become applicable to purifying purposes? It was the misfortune of managers, abroad especially, to have great difficulty in getting rid of their residuals, and ammonia water was one of the greatest bugbears a manager abroad could have to contend with. Now, in dealing with the products some years ago in Valparaiso, his attention was drawn to the use of ammonia for purifying purposes, and to a way in which it could be readily applied. He had a process by which it could be converted directly from the gas liquor into caustic ammonia, and

he found it eventually so profitable that he gave up its use as a purifying agent, and sold it to the silver reducing companies for the purpose of reducing silver from ores. He contended that the production of these compounds from the residuals was to all intents and purposes a branch of a gas manager's duty. It was simply following out the principles he ought to act upon in dealing with the ingredients which he was brought in contact with in manufacturing gas. All coal contained certain elements. He dealt with one class in manufacturing gas, and why should he not extend this skill and knowledge in dealing with that which came afterwards. If that were done it was quite evident that, if gasmen would bring that amount of knowledge to bear upon these residuals which they did in the manufacture of gas, in that proportion would they extract the benefits their residuals were capable of rendering. He held that they had thrown away for many years that which they ought to have used from the commencement, or at least since they ascertained its value for the purpose of extracting those impurities which everybody cried out against. Whether they adopted the process which he believed to be most simple and efficacious—that proposed by Mr. Hills—or that later one, in which they converted the carbonic acid of the gas into carbonate of soda, or in whatever other form it was done, it was their duty to search for the best means by which they could accomplish the work they had to do, and carry it on to the best results.

Mr. Edwards (Taunton) asked what relation did the quantity of salt first used bear to the quantity of bicarbonate of soda produced for sale? It appeared to him that the cost of the salt would be a great item in the calculation.

Mr. George Anderson said they had had that day a new chapter from an old book. It was some years ago since he asked them to look at washers, when they were all afraid of them; and some years since he spoke of the purification of gas by the ammonia contained in it, and he was glad to see scientific men, who understood a great deal about chemistry, were trying to accomplish this. He did not think, however, that it was entirely a chemical question, because they had had, for a series of years, scrubbers and washers of various descriptions, which had done a great deal of good to the gas; but did not sufficiently remove the impurities which they were put there to take out. His belief was that the reason why any impurities were left was that, first, the materials employed were not chemically correct, and next the mechanical appliances were insufficient. It was difficult for him to speak on this subject, because he was interested in it; but he would not blow his own trumpet more than he could help. He had seen last winter a scrubber worked at the Vauxhall station of the Phœnix Company, and Mr. Marshall was acting as a chemical expert in testing its action. He had had the privilege of being there several days in succession, and he found that that gentleman applied, at the outlet of the scrubber, a slightly reddened litmus solution, and the gas passed through that continuously for several days without showing a trace of ammonia; but there was nothing running into the scrubber, for the purpose of removing the ammonia, but a little clean water to the extent of about 12 or 14 gallons per ton. Therefore it seemed to him that it was the want of mechanical arrangement which permitted any of the ammonia to go forward in their scrubbers where water was used. In the scrubber to which he referred, the gas was divided up into the very smallest particles, and by bringing it so intimately into contact with the purifying material the whole of the ammonia was extracted. Mr. Wallace had spoken to him about this, because he also had seen the action of the scrubber, and he intended to use that in preference to the one shown in the diagram, with reversed angle irons. He had little doubt but that if well-purified Hills's liquor were used through a scrubber such as he mentioned, you would get all the different grades of the liquor necessary to produce the result shown on the diagram. In this case the water went from the one to the other; in the scrubber to which he referred there were five vertical divisions, each a water-tight tank doing its own work, and the water passing from the upper to the next, and so on until it came to the lower one. Another thing he should like to mention, although he knew it was treading on dangerous ground. He regretted that the gentlemen who had read papers had never once mentioned the name of Mr. Patterson, and they would not find a chemical paper on gas five years old without such expression in it. There were members who seemed not to know—although some went instinctively in the proper direction—the great necessity of removing carbonic acid from gas before beginning to purify it from sulphuretted hydrogen and other sulphur compounds. It appeared to him, and he had studied the subject for 15 years at least, that they were indebted to that gentleman for a very beautiful discovery, and he thought they ought to acknowledge or dispute it. The next point was, supposing you could, with Hills's liquor, get rid of carbonic acid, which was the difficulty—for the papers said that the liquor still contained a certain amount of carbonic acid—it was quite possible to remove the whole of the carbonic acid from gas by lime, and without producing any smell. If you could not do it in that way, you could not do it in large works in towns. He contended you could remove the whole of the carbonic acid, and the lime had no smell a yard off the purifiers. It was then a question simply of removing the waste lime containing the carbonic acid, which did contain at one time sulphuretted hydrogen, but which had all been driven off, and was now simply carbonate of lime. He would ask any gentlemen who had anything to do with the subject to let liquid purification engage their attention most, because it would be self-acting, and would save them all a great deal of trouble, and bring about the days so beautifully described, when they would have so much healthfulness and economy.

Mr. George Livesey said there were one or two statements made by Mr. Marshall which were not quite in accordance with his experience, especially that to which Mr. Hunt alluded, that by Hills's process of purifying ammoniacal liquor, you did not purify the liquor. Mr. Marshall stated that all the ammonia was combined, but he did not say to what extent it was combined. As his brother's paper had shown, it might be combined with 400 cubic inches of impurities per gallon; but if 40 inches only were combined, it still might be said to be combined, although to a very slight extent. He did not suppose one portion of ammonia would be absolutely combined to its fullest extent, and all the rest in its free state; but the whole ammonia in the purifying liquor was combined with a small proportion of impurities instead of a large proportion. It was quite possible to deprive the ammonia of all its impurities, as he had seen over and over again, only it was not advisable to do so. It required a longer process, and it was cheaper to deprive the ammonia of three-fourths of the impurities, and so to work it over an extra turn, than to deprive it of the whole, and work it not quite so often. It was merely a question of economy. As to the only way of purifying liquor by lime, as Mr. Marshall said, he was quite satisfied you could make rough caustic ammonia by the process he was using. Now came another difficulty about the scrubbers. He had never been able to get clean carbonate of ammonia. Retain the liquor in contact with the gas as long as he pleased, one, two, three, or four days, the whole of the sulphuretted hydrogen would not be expelled. He had found that they had put 10-oz. liquor into a purifying vessel, and the liquor contained, say, 1200 cubic inches of sulphuretted hydrogen to the gallon, and a like quantity of carbonic acid; they had kept that in contact with gas for 48 hours, and its strength was increased from 10 to something like 30 oz., but the sulphuretted hydrogen had still remained at about 1200 cubic inches to the gallon, whilst the carbonic acid had increased to upwards of 10,000 cubic inches. Still they had never succeeded in driving off the whole sulphuretted hydrogen. That might be explained in this way. It was not as if you had an absolutely pure substance to deal with. Would-be chemists often assumed that they were dealing with a simple substance instead of, as they were, with one of the most complex substances possible to find. The gas containing not only carbonic acid but also sulphuretted hydrogen, being brought into contact with this liquor, was continually bringing a fresh increment of sulphuretted hydrogen to the liquor, and he could easily understand that sulphuretted hydrogen would always be present. If you brought carbonic acid only in contact, you might drive off the whole of the sulphuretted hydrogen, as had been proved in some experiments which he had tried. They purified the liquor by bringing it into contact with waste gas from the furnace, containing a large quantity of carbonic acid and no sulphuretted hydrogen, and deprived that liquor absolutely of every trace of sulphuretted hydrogen, so that it could not be detected by lead paper. But then came this extraordinary circumstance. The liquor, which had been deprived of all carbonic acid when put into a scrubber, took out all the sulphuretted hydrogen from the gas. That was an absolute fact. It was an incredible fact, and he had never had it explained; but it was a certain fact that the whole of the gas for six months was purified from sulphuretted hydrogen by this highly carbonated liquor. He was afraid, unless something extraordinary were realized from Mr. Wallace's arrangement, they could not expect to get pure carbonate of ammonia. As to the profit, it reminded one of the old estimates of Mr. Winsor, about a profit of 9d. per 1000 feet for gas sold from the carbonic acid utilized. They could reduce the price of gas to about 2s. per 1000 feet, and still pay good dividends. All he could say was, he should be very glad to see it, but he was afraid there was some element omitted. It was said that there was about 2½ per cent. of carbonic acid in gas as it left the scrubbers, but he did not find that; and other engineers, with whom he had conversed, informed him they did not find anything like so much as that after the gas had been properly washed. With regard to his brother's paper, he did not wish to say much. The tables would be found interesting, and the points to which special attention might be drawn were the quantities of impurities that the liquor would absorb. He did not think his brother wished to disparage, in any way, Mann and Walker's scrubbers, when he said he had not divided that by ounces, as ascertained by the distillation test. Still there was this fact—that they had not nearly enough ammonia to purify the gas, and if they had to use it, they must use it five or six times over. He was inclined to believe it would answer the purpose to do so, but at any rate he was quite satisfied it could be done. There was one other difficulty in using caustic ammonia; it was such an exceedingly volatile article, when in the caustic state, that the gas carried it forward, and the great difficulty was to keep it in the purifying vessels. You put lime into a vessel, and there it stopped until you took it out, but you might put caustic ammonia in, and when you looked for it it was gone; and you must use a large quantity of water to prevent the ammonia being carried forward. Mr. Hammond told him of a process of his in which he applied the ammonia to the hot gas immediately on leaving the hydraulic main. In that state the caustic ammonia combined with the impurities before it reached the scrubbers, and was washed out in the ordinary way. That seemed to be a promising way out of the difficulty. Still he was in good hopes that they should see light in this matter before long, and these experiments were all tending in that direction.

Mr. Hunt said he did not intend to imply that it was not quite possible to obtain perfectly clean carbonate of ammonia in the first vessel, but he did not think it either desirable or necessary for Mr. Wallace's process. There seemed to be no difficulty whatever in eliminating the whole of the carbonic acid and sulphuretted hydrogen by the ammonia process.

Mr. Vernon Harcourt wished to put a question to Mr. Frank Livesey. The chief value of the process seemed to be not the removal of the sulphuretted hydrogen, which could not be better done than by oxide of iron, but the removal of the carbonic acid. The important service which this approximately purified ammonia could render was that of removing carbonic acid. There was a great chemical advantage in using that over lime, because the quantity of ammonia which would remove a given quantity of carbonic acid could be produced much cheaper by this process than the quantity of lime which would remove the same amount. He wished to ask, however, whether it was found that, by the adoption of this process, it was possible at the South Metropolitan Gas-Works to remove the carbonic acid from the gas as effectually as before with the use of a smaller quantity of lime? That, he thought, was a measure of the value of the process as now used. One word with reference to what Mr. George Livesey stated as an almost incredible fact. It certainly did not seem to him to be even surprising. If you took a solution of carbonate of ammonia and shook it up with sulphuretted hydrogen, you formed sulphide of ammonium, and set free carbonic acid. If, on the other hand, you took a solution of sulphide of ammonium and shook it up with carbonic acid, you formed carbonate of ammonia, and set free sulphuretted hydrogen. The fact was that the condition of the outlet would always resemble the condition of the gas which was mixed with it, or passed through it. You could increase the proportion of carbonic acid, and decrease the proportion of sulphuretted hydrogen; but you would always have, if the gas contained both, some of both gases in the solution.

Mr. Chandler said he was no chemist, but rather followed in the footsteps of Mr. George Anderson, and he might just make a statement with regard to the effect at the Bromley station. Mr. Marriott was conducting experiments with this solution for the purification of gas from sulphuretted hydrogen and carbonic acid, but he omitted to state the vessel in which Mr. Marriott was conducting this experiment. The apparatus in which this Marriott's solution was being tried was known as Kirkham, Hulett, and Chandler's washer. This vessel, like his, had a number of divisions. It was a horizontal vessel, 17 feet long, divided into ten different bays, each of which was charged with water to start with, and as the gas passed through, the water became strong liquor.

The President, interposing, said they were discussing the principles of the papers read, not the details of different scrubbers.

Mr. Hammond (Lewes) said he had recently distilled some caustic ammonia, and brought some in a bottle, and if any gentlemen liked to examine it they could do so. It was readily produced by the process he had in work at Lewes. He not only took the crude ammoniacal liquor from the well and distilled it for the caustic ammonia, but he afterwards recovered the ammonia by washing in suitable vessels, and made a marketable product in the shape of sulphate of ammonia. The process was very effective for the removal of carbonic acid and sulphuretted hydrogen.

Mr. Anderson asked if Mr. Hammond used lime.

Mr. Hammond said he took the crude liquor and put it into boilers, and drove off the foul gases—carbonic acid and sulphuretted hydrogen to a very great extent—through acid in a closed saturator. He made a certain amount of sulphate of ammonia by the process, then shut the valves, and had a closed iron vessel capable of resisting great pressure, into which he drove high-pressure steam. That expelled the air contained in the vessel.

Then he mixed cream of lime in a tub, shut the steam from the iron vessel, and produced a vacuum, which sucked, from the top of the tub, the cream of lime; the sediment was not drawn over, but the cream of lime only, which mixed most readily with the water. High-pressure steam was again turned on, and the whole of the contents blown directly into the crude ammoniacal liquor with which he started; then this was agitated in the boilers from which he made the sulphate; then he opened a tap and passed the gas, not again through the saturator, but through an apparatus to regulate the temperature, and from that it passed direct to the hydraulic main, at the extreme end. He could put it into the extreme end of the hydraulic main, either in the form of a vapour or liquid, to mix with the gas; it flowed readily past each dip-pipe, and mixed with the gas as it passed out. He produced a bottle of the liquid, obtained directly from the apparatus before it passed away with the steam into the hydraulic main; also a bottle of the liquid taken out from the hydraulic main, the valve of which had been broken.

Mr. F. Livesey said that, with reference to Hills's liquor, it was very evident it would do the work. The liquor, before it was purified, contained 2076 cubic inches of H_2S, and 867 afterwards. The carbonic acid was 2002 cubic inches before, and 489 after, showing that the carbonic acid was reduced to one-fourth, and sulphuretted hydrogen to less than one-half. Mr. Anderson had referred to Mr. Patterson. They all knew Mr. Patterson did make a discovery that lime would not work unless carbonic acid was absent, and this was so well known that he thought it hardly necessary to mention it. It was also found it would not work when sulphuretted hydrogen was present; it would not take out the sulphur compounds if that gas was present in large quantities. Mr. Vernon Harcourt asked a question about the carbonic acid after passing through the washers. They had found there was about one-half per cent., and sometimes less, of carbonic acid, and by that means they were able to do away with the carbonic acid boxes. After the washers, the lime, which the gas came in contact with, acted as sulphide to remove the sulphur compounds; if they did not use Hills's liquor they would require carbonic acid boxes.

Mr. Marshall said they were working with Marriott's process with an ordinary 24-inch pipe filled with coke, and they had very good results. With regard to Mr. Anderson's observations, he quite agreed that this process was not entirely a chemical one—in fact, in his paper he had drawn particular attention to the mechanical portion. The angle plate was not a patent, and was open to any one who liked to adopt it. Mr. Anderson also said he used the litmus solution at the outlet of one of his washers. That was the ordinary acid process, and he found good results. He was sorry he had missed naming Mr. Patterson, but his name was well known. With regard to Hills's process they might discuss that for all time, but he was in a position to give an analysis of the figures obtained from a boiler where it was under trial, and the results of his experience were these—If the liquor was not heated up to a certain temperature, the action would not take place causing separation of carbonic acid, ammonia, and sulphuretted hydrogen. If you heated it a little more, the action did take place to a certain extent, but the washing power or condensing power required to condense the gas again to the normal temperature was very great; but in the samples that were taken, the ammonia existed in the free state only to the amount of ·01024, and the rest as sulphide and carbonate of ammonia. In the face of these figures, he maintained that the action was not complete. Again, admitting it was complete, and that it did drive the carbonic acid into the carbonate of lime, would they be able to dispose of it? There was no carbonate of lime in Mr. Hills's process. The sulphuretted hydrogen was driven forward as oxide; in this the compounds of the ammonia as sulphide of ammonia were used for taking out the bisulphide of carbon compounds. Mr. Harcourt's observations were somewhat similar to Mr. Anderson's—that it was not a chemical but more a mechanical change they had to turn to. Mr. Gore only told them what they already knew—that they must work up the compounds; and any gas companies who wanted to go into this operation would, no doubt, put in a clause which would enable them to start chemical works. But they need not do so; they could sell the products to chemical works. Mr. Hammond's process appeared very feasible; but he used milk of lime, and got carbonate and sulphide of calcium in the same degree, and this was most voluminous and most difficult of disposal. What they wanted was a process for doing away with the liquid sulphide of calcium, and only getting products which would be useful. As to looking at this matter only in a chemical point of view, he was not a chemist, but a gas-maker, and he really found that chemists were the most unpractical men. With regard to Mr. Hammond's observations that the first tower contained a mixture, and that the gas coming into the scrubber contained sulphuretted hydrogen as well as carbonic acid in considerable quantities, that might be so until you got a pump, when you would displace the sulphuretted hydrogen. These experiments showed that over and above the sulphuretted hydrogen driven off there was 0·66 of free sulphuretted hydrogen left in in the liquor drawn from the first tower; and it was not in combination, but existed chemically in the free state. Supposing the decarbonated ammonia did contain sulphuretted hydrogen, it would not matter, because on being placed into the water-tight vessel whereby the carbonate of ammonia was driven off, you might so arrange the condensers that sulphate of ammonium would be condensed in the first vessel, and the carbonate of ammonia driven forward in the last series, so that from them you could draw off the carbonate of ammonium, take up the sulphate in the first, and pop that back again to the gas, so that you would have no smell and no loss of sulphuretted hydrogen. As regarded the desulphurating liquor boxes, patented by Mr. Livesey, there was no doubt the hot furnace gases would so warm up the gases, that the amount of power required to cool the furnace gas would be a considerable item in the expense, and there would be the objectionable carbonate of lime to deal with. The profits did seem enormous, but they were given by the inventors, and when they came to look at the amount of carbonate of soda sold, he did not think they would be found very excessive.

The President said he should like to have said a few words with reference to these papers, not so much with reference to the particular process, which had been very lucidly explained by Mr. Marshall, as on the general question of purification by liquids. But he felt that any observations he could make would not outweigh the consideration that they had very much more work to do, and as there were several papers yet to read, he would not detain the meeting.

Mr. G. E. Davis (Manchester) read a paper on

THE CORRECT ESTIMATION AND VALUATION OF RESIDUAL GAS PRODUCTS.

The chemical examination of residual gas products has not, as yet, for purposes of valuation, reached any stage of exactness. I know of no case where a gas-works disposes of its liquor at a fixed price of so much per unit per ton of ammonia, or sulphate of ammonia; but I do know of several instances where gas water is sold on this basis, by tar distillers to chemical manufacturers, to the obvious advantage of the former.

Gas water is only valuable for the ammonia it contains, then why should not a rational system of valuation be adopted, depending upon the amount of active material, rather than a system, barbarous and empirical, like that of selling the gas water at so much per ton of coal carbonized.

To a chemical manufacturer there is a certain risk to run in buying by such a method, and it would be absurd to suppose that as high a price would be offered with a risk as without one, the buyer has the advantage, the seller the disadvantage. The same may be said of the method of selling per degree of Twaddell's hydrometer. Some books state that gas water contains free ammonia. This may be the case, but I must confess that I have never been able to find it; on the contrary, I have never found enough ammonia to saturate the carbonic acid and sulphuretted hydrogen in proportion necessary for the formation of normal salts of ammonia. The acids have always been in excess.

Mr. Child, in a paper read before you in 1876, pointed out the fallacies of the tests in present use; but his explanation, in paragraph 5, is hardly correct. Gas water is of a greater specific gravity than water, because it contains carbonate and sulphide of ammonia, and it is easy, on the large scale, to simply distil this off without lime, when a distillate is easily obtained, 16° Twad., containing carbonate, bicarbonate, and sulphide of ammonium. The fixed ammonia remains in the still. The following experiment will show this clearly:—

Some gas water of 1·025 sp. gr., or 5° Twad., was examined with these results—

	Per Cent.
Ammonia by standard acid	1·270
Ammonia by distillation with lime	1·700
Carbonic acid	1·694
Sulphuretted hydrogen	0·157

100 c.c. of this gas water were heated; effervescence commenced at 182° Fahr.; much gas given off at 206° Fahr.; ammonia and sulphuretted hydrogen evolved at 208° Fahr.; all effervescence ceased at 210° Fahr.; 92 c.c. were left, which were made up with pure water to 100. The liquid was then 1·007 sp. gr., or 1¼° Twad., and contained—

	Per Cent.
Ammonia by standard acid.	0·35
Ammonia by distillation with lime	0·79
Carbonic acid.	0·11
Sulphuretted hydrogen	Nil.

Equivalents ammonia liberated, 5·41; equivalents carbonic acid and sulphuretted hydrogen liberated, 4·06; formula of salt liberated $(NH_3)_5$, $(CO_2)_3$, in which a little of the carbonic acid was replaced by sulphuretted hydrogen—constitutional water, of course, in addition.

But to return to the methods of estimation now in use. The saturation of the gas water by sulphuric acid should never be adopted as a means of valuation at any gas-works, as the foregoing experiments prove. The gas water, if sold by this test, would contain apparently only 1·27 per cent. of ammonia, whereas it really contained 1·7 per cent. or nearly 30 per cent. more.

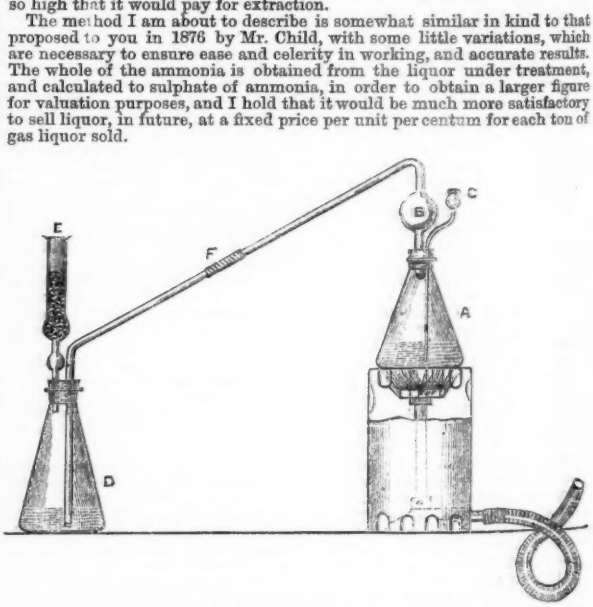
Having said so much against the methods now in use, you will be inquiring how should it be done; and, in reply, I must say that first it is necessary, before fixing upon any method, to see what gas liquors generally contain. The following is the result of an analysis of gas water which I made some time ago:—

Sp. gr. 1·0362 = 7¼° Twad.

	Grammes per Litre.
Ammonia by standard acid	29·00
Fixed ammonia.	5·08
Sulphuretted hydrogen.	9·23
Carbonic acid	31·46
Hyposulphurous acid	1·21
Ferrocyanic acid	Traces.
Sulphocyanic acid	13·94
Carbolic acid	Traces.

Gas waters vary much in their composition, but they always contain the above ingredients in more or less proportion. Some are rich in carbolic acid and very poor in sulphocyanides, while in others the ferrocyanide is so high that it would pay for extraction.

The method I am about to describe is somewhat similar in kind to that proposed to you in 1876 by Mr. Child, with some little variations, which are necessary to ensure ease and celerity in working, and accurate results. The whole of the ammonia is obtained from the liquor under treatment, and calculated to sulphate of ammonia, in order to obtain a larger figure for valuation purposes, and I hold that it would be much more satisfactory to sell liquor, in future, at a fixed price per unit per centum for each ton of gas liquor sold.



The above sketch shows the apparatus employed, which is of the simplest kind—measuring flash, 250 c.c.; a burette and two pipettes are also needed. Some milk of lime, 10° Twad., a standard solution of sulphuric acid of such a strength that 100 c.c. neutralize 5·3 grammes of pure carbonate of soda, and a standard solution of caustic soda of the same strength, with a solution of litmus, are all the solutions required.

In order to avoid the use of a balance for weighing off the ammoniacal liquor, I have constructed the following table, showing the quantities to be taken in cubic centimètres of liquor at various degrees on Twaddel's hydrometer, to be equal to the 66 grammes which have to be taken:—

Deg. Twad.	C.C.	Deg. Twad.	C.C.
1	65·67	4½	64·55
1½	65·64	5	64·40
2	65·34	5½	64·23
2½	65·18	6	64·07
3	65·02	6½	63·92
3½	64·86	7	63·76
4	64·70	7½	63·61

The operation can be better described by giving an instance. Gas liquor 6° Twad. 64 c.c. of the gas liquor (or 66 grammes) are taken from the sample by means of the pipette, and placed in the 250 c.c. measuring flask, then made up to the mark with water and well shaken. One-tenth of this, or 6·6 grammes are then placed in the distilling flask, A, and the cork containing the bulb, B, and the funnel, C, fitted to it as shown on diagram. The receiving flash, D, is then partially filled, as shown, with 20 c.c. of the standard sulphuric acid, which is run in through the scrubber, E, filled with glass beads. The acid is then coloured with litmus. 100 c.c. of water, and 20 c.c. of the milk of lime are now added to the distilling flask, the flask brought to a boil, and kept boiling for half an hour. The bulb tube, B, is placed as a safeguard against frothing, which sometimes happens during the boiling, anything condensing in this bulb runs back into the flask again. After the expiration of half an hour, all the ammonia will have been driven off into the flask, D. The apparatus is, therefore, disconnected at F; the tube, E, well washed into the flask, D; the standard soda solution added until the litmus remains neutral, and is no longer red nor blue. The number of cubic centimètres of alkali or soda solution subtracted from the 20 c. c. of acid used gives the per centage of sulphate of ammonia without any calculation.

Thus 64 c.c. of gas liquor, at 6° Twad., were diluted to 250 c.c., and 25 c.c. of this put into the distilling flask, and 20 c.c. of standard acid into the flask, D; 100 c.c. of water and 20 c.c. milk of lime were then added to the distilling flask, and boiled for half an hour. E was then washed down into D, and standard acid added, of which 9·9 c.c. were required; therefore the gas liquor contained ammonia equal to 20·0 − 9·9 = 10·1 per cent. of sulphate of ammonia.

Milk of lime is used because caustic soda is not without action upon the cyanides which the liquor contains.

The following results of the examination of gas waters may not be uninteresting:—

Source.	Deg. Twad.	Per Cent. Sulphate Ammonia.	Per Cent. NH_3 by Stand. Acid.	Per Cent. CO_2	Per Cent. H_2S.	Eqs. NH_3 to $CO_2 + H_2S$.	Value at 4s. per deg. Twad.	Value at 2s. 6d. per Unit. Col. 2.
Stalybridge . . .	4¼	5·5	0·90	1·330	0·154	1·45	19s. 0d.	13s. 9d.
Macclesfield . . .	6	8·0	1·10	1·410	0·034	1·97	24 0	20 0
Bury	5	6·6	1·375	1·694	0·157	1·74	20 0	16 6
Salford.	6	9·6	1·84	2·110	0·154	2·00	24 0	24 0
Oldham	6¾	9·0	1·94	3·056	0·128	1·56	27 0	22 6
Stockport	6	6·8	1·10	2·300	0·250	1·09	24 0	17 0
Runcorn	5½	6·6	1·00	1·385	0·018	1·84	22 0	16 6
Private Gas-Works .	6	10·1	1·48	2·508	0·484	1·22	24 0	25 3
Middleton.	7	11·6	2·60	3·984	0·149	1·61	28 0	29 0
Blackburn	4¼	7·6	1·17	1·560	0·050	1·86	18 0	19 0
Congleton.	4½	7·76	1·62	2·040	0·190	1·83	18 0	19 4
Dukinfield.	6¾	11·48	2·36	2·750	0·160	2·00	27 0	28 8
Rochdale	5½	9·38	1·98	2·620	0·190	1·77	22 0	23 5

The sixth column shows that there was no free ammonia in any of them, and the last two columns show the values; first calculated at 4s. per degree Twaddel per ton, the second at 2s. 6d. per unit per cent. of sulphate of ammonia per ton of liquor delivered into a manufacturer's works—its present value.

Turning to another residual product of gas-works—*i.e.*, tar—I may say that as yet there is no ready laboratory method for the valuation of this, and results obtained in the laboratory would, I am afraid, be of but little use, as it held that some of the products obtained from a tar-still were not originally present in the tar, but formed in the still during the process of distillation by the action of some of the ingredients upon others there present.

Last, though not least, comes the question of the analysis and valuation of spent oxides, and I must say that all the methods that have been employed for this purpose (as a chemist I am almost ashamed to say it) in general use are, and have been, incorrect—grossly incorrect at times, giving no idea of the value of the article. Not only the available sulphur has been wrongly estimated, but a simple thing like an ammonia estimation has been so bungled over by many a chemist, that I have known serious commercial difficulties and wrangling owing to the faulty method the chemist employed. I cannot blame the commercial men in these matters, even though they are rather sharp in taking advantage of the faults of the "high" or "low" analyst as may serve their turn; but I do blame chemists for not acquainting themselves more fully with the details of their subject, and this and many other questions of a similar nature only show one more clearly the deplorable state of technical chemistry in this country, and show also how little exertion is made by technical chemists to help to drag their profession out of the mire.

In the *Chemical News* of Jan. 16, 1874, p. 30, I first pointed out that the value of spent oxide did not entirely depend upon the amount of sulphur which it contained; and it was customary then to perform the analysis by oxidizing the sulphur to sulphuric acid, and finding the difference between that as "total sulphur," and the sulphur existing as sulphates. This method was, however, abandoned for the bisulphide method, as it is called, which is most incorrect as a general method of analysis, for, as a rule, it not only estimates the tarry matter as sulphur, but it cannot show the variations in the quality of the article, which any test for technical purposes should do. It is possible to make such a spent oxide show abundance of sulphur by the "bisulphide test," yet a vitriol manufacturer could not produce any sulphurous acid by burning it.

A test, to be of any value, should be such a one as would show even small variations between various samples, and one which would point to the exact amount of any injurious element introduced which would detract from the value of the spent oxide.

After some years of experience in the analysis of spent oxide, I devised a method which overcame all difficulties, which is termed "the combustion method." This method is very fully described in the *Chemical News* for Oct. 26, 1877, p. 188,* and as it is rather a lengthy description, I will not weary you by going into details; suffice it to say that the sample of oxide is first washed and dried, and then burnt in a stream of dry air in a combustion furnace. Though the process is very rapid, simple, and accurate, it could not be described so well as exemplified, and I should, therefore, be most happy to show any persons the process working, or give them any instructions so that they may work it themselves.

It is not, however, necessary that a gas manager should trouble himself at all with sulphur analyses. I have pointed out in another paper that it is only necessary to determine the amount of oxide of iron in order to see whether an oxide is spent or not, the estimation of the sulphur may well be left to the analytical chemist when the sample is to be sold.

The moisture in spent oxides is very easily estimated. A given quantity—say 5 grains—is dried in the water-bath until it ceases to lose weight, which generally happens in about two hours. The loss in weight, multiplied by 20, gives the moisture per cent.

* Reproduced in the JOURNAL of Nov. 20, 1877, Vol. XXX., p. 802.

The ammonia has now to be estimated. Spent oxides usually contain the following salts of ammonia:—Chloride, sulphate, ferrocyanide, sulphocyanide, and some prussian blue. Until quite recently the usual plan for the estimation of the ammonia was to boil a weighed quantity of the oxide with caustic soda, in the flask before described, and collecting the evolved ammonia in standard acid. This method is extremely erroneous; for, not only ammonia from the salts of ammonia is evolved, but the chemist who operates thus produces ammonia from the ferro and sulphocyanides, which these oxides often contain in abundance.

Oxide, when spent, is valuable only for the salts of ammonia, which, being soluble in water, should be easily washed out. The sulphur present is, of course, also valuable.

The only correct way to analyze spent oxides for the ammonia they contain is as follows, the results being brought out as sulphate for valuation purposes:—

Take 6·6 grammes of the oxide for analysis, and place it for two hours in the water-bath to dry—this is for the purpose of making it wash readily, and to prevent the prussian blue from washing through the filter. This quantity is then digested with water, and the whole brought into a filter; the residue being washed until free from ammonia. The filtrate is then placed in the distilling flask, A, and the operation conducted precisely as described for gas water, the number of cubic centimètres of standard acid used, less the cubic centimètres of soda, gives the per centage direct of sulphate of ammonia, without any calculation. On no account must the oxide itself be boiled with caustic soda, and those chemists to whom I have pointed this out all agree with me in this respect.

I have lately had some correspondence with Dr. Voelcker upon this subject, and he has given me permission to state that he finds my argument correct, and also says that in future he shall always adopt the method of washing out the salt of ammonia, and estimating the ammonia in the watery solution.

Mr. EDWARDS asked if the ammonia could be estimated as chloride instead of sulphate.

Mr. DAVIS replied that the ammonia could be estimated quite easily by several means. It was driven off, and kept as ammonia. It was calculated as sulphate on purpose to have a fixed standard of valuation.

Mr. G. E. STEVENSON (Peterborough) read a paper, entitled

SOME NOTES ON THE CONSTRUCTION OF RETORT-SETTINGS.

The setting of retorts has formed the subject of so much discussion, and been so ably considered in papers read at former Meetings of this Association, that I should not have felt justified in occupying your time with a paper on this question, were not the retort-setting so all-important a feature in the construction and working of gas-works, and one which, notwithstanding the attention which has been devoted to it, is still far from being exhausted, or even satisfactorily settled, either as regards the principles to be observed, or the form in which these are to be carried out. Having myself obtained very satisfactory results from settings which have been constructed with a view of embodying, so far as possible, principles which I believe to be correct, I have ventured to bring forward a short paper for your notice, comprising a description of the settings and a statement of the principles I had in view in constructing them.

In the first place, I will take it as an axiom that the primary object to be held in view in constructing a setting of retorts is to get as much gas as possible out of each ton of coal carbonized, of the quality prescribed by the Act of Parliament under which the undertaking is worked. This, I think, all will agree with, for, though some may consider it undesirable to obtain so large a yield of gas per ton as to necessitate the use of cannel, or other carburetting agent, to bring the gas up to the standard quality, every one will see that, given a certain quality maintained, every 100 feet of gas extra out of a ton of coal is a direct gain, which may be estimated according to the cost price of the gas produced.

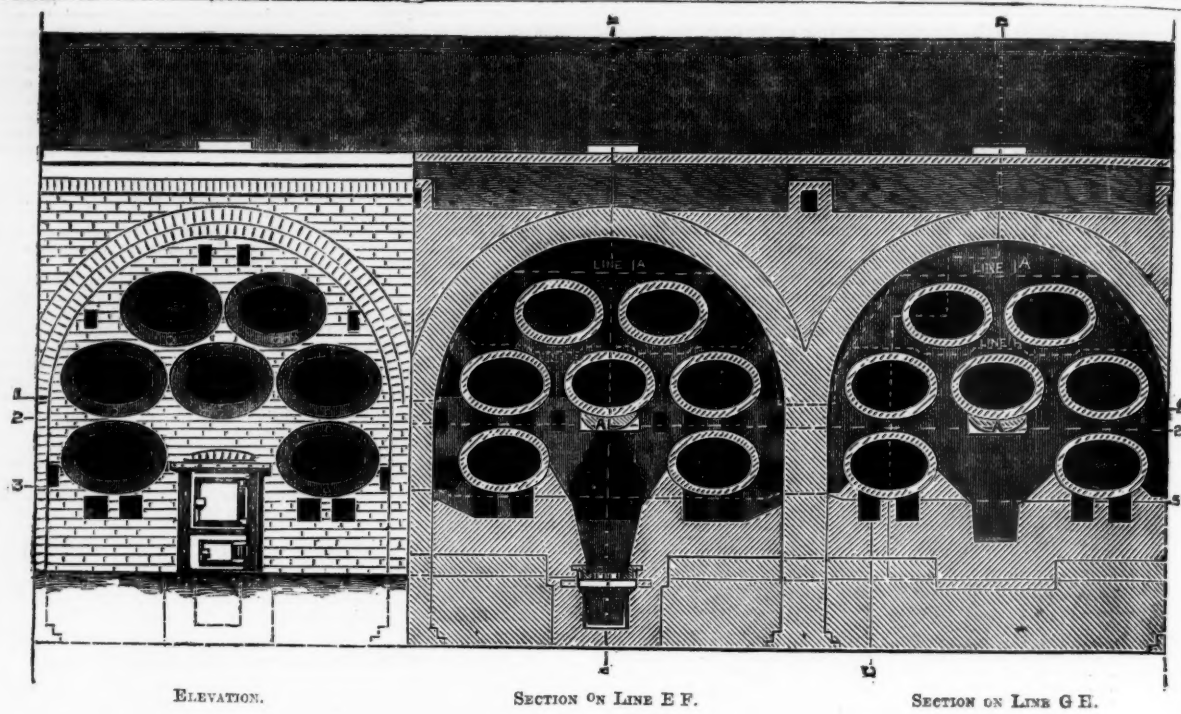
I will also state my opinion at the outset, that no economy in other directions, such as a lengthened durability of retorts, saving of fuel, or cheapness of construction, will compensate for a reduced production of gas per ton of coal carbonized.

Holding these principles in view, it appeared to me that the heat generated in the furnace of a retort-setting is often dissipated throughout a large quantity of brickwork, which is introduced into the setting under the plea of being necessary for the proper support of the retorts. It is a common thing to see a very intense heat in the furnace of a retort-setting, and, at the same time, an indifferent one in the retorts. This is most commonly the case with settings of seven retorts, in which the middle retort is situated immediately over the fire, and supported by a continuous arch having nostrils, through which the heated gases of combustion pass into the setting. The same thing exists in a lesser degree when the arch is not continuous, but divided by spaces, as where cross walls are used, and with the additional disadvantage that those portions of the retort which are left exposed to the fire are rapidly destroyed.

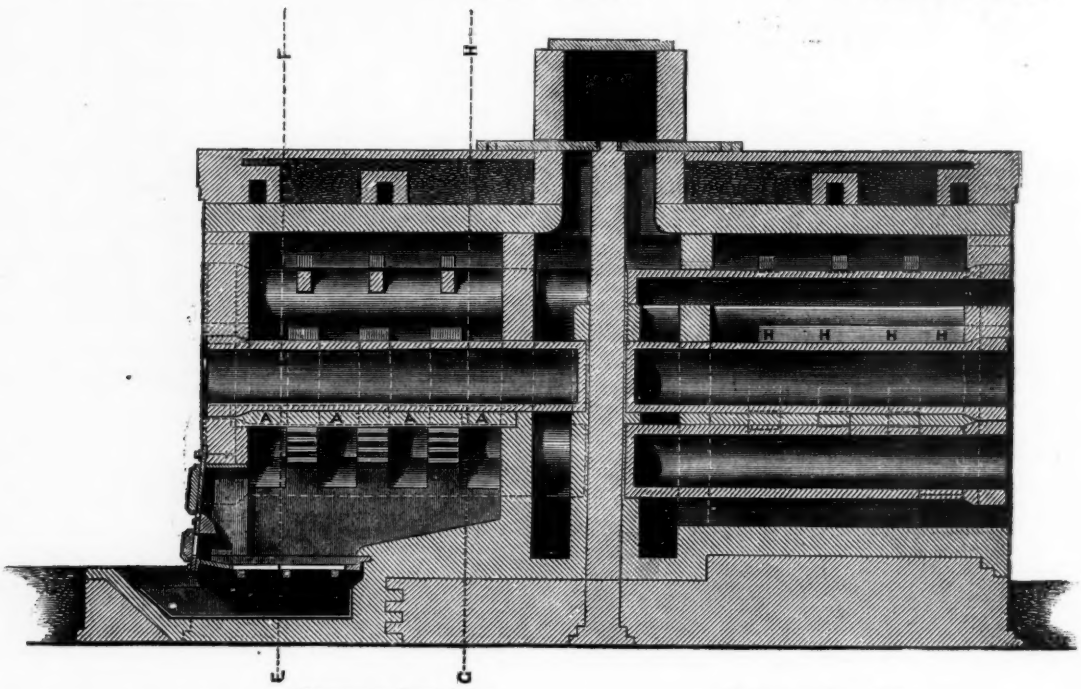
The reason of this inequality between the degree of heat developed in the furnace and that attained in the setting itself is to be found in the absorption of the heat by the surrounding brickwork, and its dissipation over a large area of heat-conducting material; for, given a certain quantity of heat generated—that is to say, a certain number of heat units evolved, and the intensity of the heat developed will be in inverse proportion to the extent of the medium presented for its absorbtion.

Now, I am aware that some managers are of opinion that it matters little how much internal brickwork a retort-setting contains, for, say they, the heat which the brickwork absorbs is given out again at a future point in the process of working, and a large quantity of heated brickwork acts as a reservoir of heat, giving out and taking in, according to the necessities of carbonization. This is only true to a limited extent, because fire-clay is a bad conductor of heat; and, while a portion of the heat absorbed by the brickwork may be imparted to the retorts in time of need, by far the greater part of it finds its way, by radiation from the surface of the brickwork, through the damper direct into the main flue. With proper working arrangements, also, such a reservoir of heat presents no appreciable advantage, while the prejudicial effect of such construction, in diminishing the intensity of the heat developed, is easily made evident. A little consideration is sufficient to show that it is not the total quantity of heat evolved which is the criterion of the gas-making capacity of a retort-setting, but the degree of intensity developed, or the pyrometrical effect of the combustion. Experience shows that a much larger quantity of gas is produced from a ton of coal if the distillation be conducted at a high heat than at a low one, and also that if the value of gas as an illuminating agent be expressed in pounds of sperm, a far better result is obtained with a high heat than with a low one, for the obvious reason that with a high heat much of the light-giving hydrocarbons is converted into permanent gas, which would otherwise remain in the residuals. In addition to this, the higher the heat, the shorter the period required for carbonization, and the greater the work done by each retort within a given time.

What we want, therefore, is to get a degree of intensity of heat in the settings more nearly approaching that of the furnace, and the way to do this is to oppose as little obstruction to the passage of the heat to the retorts as possible, and to present to the currents of heat the least possible absorbing surface other than that of the retorts themselves.



ELEVATION. SECTION ON LINE E F. SECTION ON LINE G H.



SECTION ON LINE A B. SECTION ON LINE C D.

In carrying out these views, so far as the form of my retort-settings would allow, I altered four settings last year in accordance with the drawings exhibited. The retorts in this setting are oval shaped, 9 feet long internally, and 21 by 15 inches in section, and the settings are placed back to back in the centre of the retort-house. The alterations made in the setting of the retorts were as follows:—In the place of arches under the centre retort corresponding with the cross walls, I set the retort on a saddle, A, constructed of four blocks, each 1 foot 9 inches long, and butting together, the joints being situated over the centre of each transverse support. The transverse supports are carried up from the sides of the furnace and projected over in courses, each course projecting 1½ inches, the projecting courses being constructed of blocks 9 inches square and 3 inches thick. The unsupported central portion of the saddle is 9 inches in width. The saddle is 4½ inches thick at the centre, and is rounded at the sides, between the supports, to obviate cramping the passages for the currents of heat.

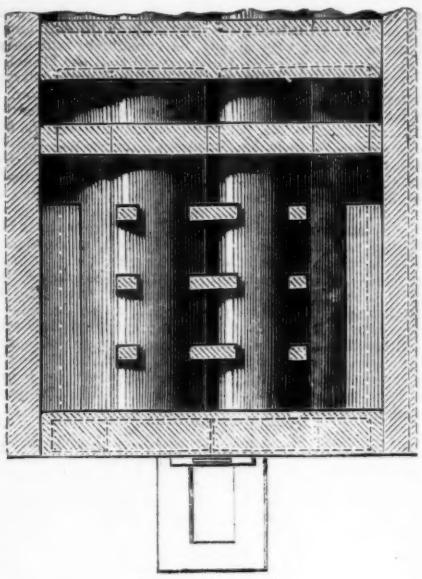
The side retorts are supported by blocks, as shown, and the upper retorts rest on saddles placed upon the middle retorts, and a brick on edge pier placed between them. The spaces between the lower and upper side retorts are blocked by a single course of bricks set in the centre line of the retorts. The blocks, H, stop the passage of the currents of heat to the sides of the setting except for a length of 14 inches from the back wall, where they are discontinued.

The flues under the lower retorts are divided by a midfeather for the better support of the retorts, but the draught is taken through both divisions in the same direction simultaneously, there being a communication to both sides of the flue at the front end as shown. These flues deliver the currents into a back chamber, 1 foot wide, in which they ascend to the main flue at the top. There are three sets of transverse supports, each of which is 9 inches thick, and the spaces between the supports are about 1 foot in width.

The furnace of this setting is 1 foot wide at the bottom, and 18 inches at the top; it is filled with fuel to a depth of two feet, and has a capacity of about 10 cubic feet. The fire-grate is 3 feet long, and reduced by the dead plates at the side to a width of 9 inches. The two fire-bars are of 1¼ inches square iron, and the spaces left for the passage of air are 2 inches wide. There are two furnace doors, the upper one for filling and the lower one for clinkering, and an inclined dead-plate 10 inches long is fixed between the door-frame and the fire-bars, which hinders the fierce combustion of the fuel in close proximity to the furnace-doors. The front wall of the setting is 14 inches thick.

The work done by these settings is as follows:—Each setting, when at full work, carbonizes 3½ tons of coal in 24 hours, and produces about 35,000 feet of gas, or 5000 feet per mouthpiece. The charges are about 2 cwt. each, and of five hours duration. The average quantity of gas produced is rather more than 10,500 feet (average of half year ending Dec. 31, 1877, equalled 10,580 feet) per ton of coal, and the quality of the gas about 15 candles, as tested by Sugg's No. 1 "London" burner. The coal carbonized is exclusively Silkstone coal, no cannel whatever having been used. The fuel account is 23 per cent. of the coal carbonized, as weighed into the furnaces.

Before the settings were altered to the present design, the retorts were set with arches over the furnace, and with four cross walls, the walls and the spaces between them being alike 9 inches wide. The position of the retorts was the same, and the furnace was of the same dimensions, except as regards depth, the arch preventing it from being so deeply filled as at present. The average make of gas was then about 10,200 feet per ton, and 4000 feet per mouthpiece per diem, the fuel account being 26 per cent. As out of seven settings employed during last winter only four were constructed on the new plan, the results which I have given may be considered to be below what could have been obtained if all the settings at work had been of the new design; but they are sufficient to show the im-



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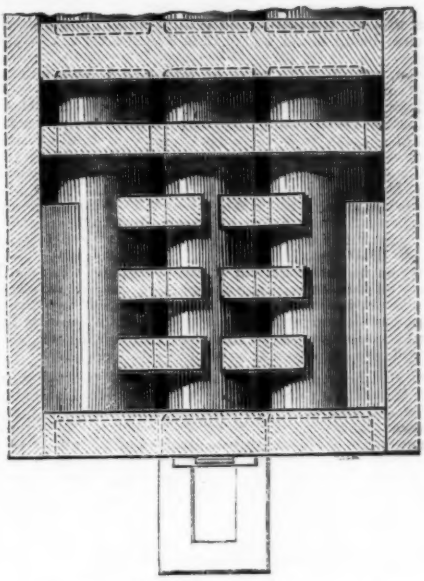

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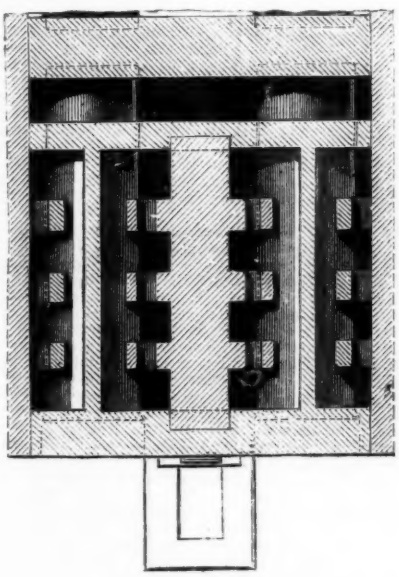

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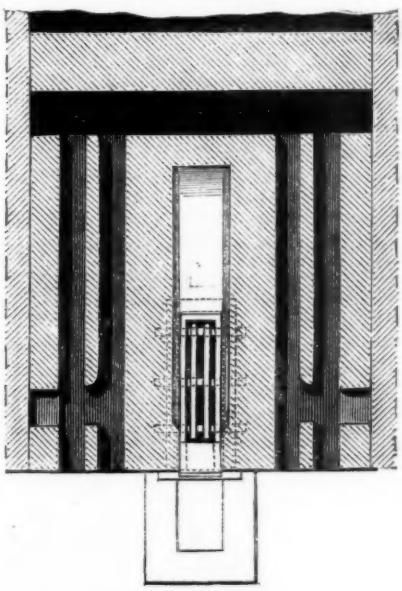

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provement gained as the result of the alteration, and to prove conclusively that an excess of brickwork in a retort-setting is prejudicial to the attainment of good results.

In order to show how groundless is the supposition that it is necessary to have plenty of brickwork to act as a reservoir of heat to equalize the heat of the retorts according to the stress put upon them, I will just mention that the retorts in my setting heat quite uniformly, the bottom retorts being equally hot with the upper ones, and there is no appreciable variation in the heat at any time during the 24 hours, except just after clinkering, when a slight reduction takes place. The retorts are charged in three separate lots at equal intervals in the five hours, and thus a uniformity is maintained in the work which the setting has to do.

The results obtained by these settings are not very extraordinary or surprising, but I think that I may claim for them that they are good results, and such as may be taken as a very fair standard of what a retort-setting ought to perform. This being the case, it may be of interest to note the proportions which the area of retort surface bears to the coal carbonized, and the proportions of the furnace and flues in relation to the same, and therefrom deduce some rules for future guidance in the setting of retorts.

In these settings, the area of heated retort surface may be estimated at 330 square feet; in making which calculation I take the circumference of the retorts at a line passing round the retorts midway between the inner and outer diameters, and I allow something for that portion of the retort next the mouthpiece, and embedded in the front wall of the setting. The quantity of coal carbonized in these settings in 24 hours I have stated to be 3½ tons. This is about one ton per 100 square feet of retort surface, and as from each ton of coal 10,500 cubic feet of gas are produced, each square foot of retort surface produces rather more than 100 cubic feet of gas in 24 hours.

The quantity of coke consumed as fuel in each furnace is 16 cwt., or 1792 lbs. per day of 24 hours. As coke contains 90 per cent. of carbon, this is equivalent to 1613 lbs. of carbon burnt in 24 hours. One pound of carbon requires the supply of 2·66 lbs. of oxygen for its combustion, and as in the atmospheric air there are 3·33 lbs of nitrogen to each pound of oxygen, 11½ lbs. of air will be required for each pound of carbon, or

$$\frac{1613 \times 11{\cdot}5}{1440} = 12{\cdot}88 \text{ lbs.}$$

of air supply per minute. One pound of air is equal to 13·03 cubic feet in volume at the normal atmospheric pressure, therefore, 167·8 cubic feet of air must pass through the fire-bars per minute, or rather less than 3 cubic feet per second. The area of the fire-grate is 3 square feet, and that of the air spaces in the same is 1½ square feet; the air, therefore, passes into the furnace at a velocity of 2 feet per second. The flues under the bottom retorts have a collective area of 1½ square feet, therefore equal to that of the air spaces in the fire-grate.

The draught in the furnaces is sufficient to create a thorough combustion and a very intense heat, but no roaring is heard, and there is no cutting away the brickwork or retorts at points where angles occur, or contractions take place in the air passages. From experiments made, I have found the draught in the furnaces to equal a vacuum of 0·07 of an inch of water; in the bottom flues it increases to 0·12 of an inch, and in the main flue it is 0·20 of an inch. The dampers are kept open about 3 inches in the regular course of working.

From these particulars, the following rules for approximate proportions in the construction and working of retort-settings may be deduced:—

1. A retort-setting should carbonize one ton of coal per 100 square feet of retort surface per diem.
2. Every square foot of retort surface should produce 100 cubic feet of gas per diem.
3. The capacity of the furnace should be regulated by the extent of the retort surface to be heated, and, when coke is used for fuel, may be ascertained by dividing the number of square feet of retort surface by 33, which will give the capacity of the furnace in cubic feet.
4. The retort surface divided by 100 will give the area of the fire-grate, and the fire-bars and spaces should severally occupy half this area.
5. The flues, under the bottom retorts, should have a collective area equal to that of the fire-grate spaces. This should be the case with all openings for the passage of the heated gases, except the opening into the main flue, where the damper is situated, which, if the chimney be of any considerable height, need not have so large an area.
6. To heat 100 square feet of retort surface, 1 cubic foot of air supply per second is required, and the main flue and chimney, as well as the retort-settings, should be constructed with due regard to this principle.

As a practical remark, in addition to the above rules, it may be said that to obtain a uniform heat in a retort-setting, it is important to have plenty of room in the setting for the passage of the currents of heat, and to allow ample area in the fire-grate and flues. When this is not the case, an unnecessarily strong draught is required to be exerted by the chimney to assist the combustion of the fuel, and the cutting draughts in the flues which occur rapidly destroy the retorts and brickwork. The heating of the retorts is also irregular, those situated immediately over the furnace being very hot just in the middle, and those at the sides and bottom being indifferently heated. It is also important that the front wall, and all

other exterior walls of the setting, be as thick as it is convenient to make them—14 inches being much better than 9 inches for the front wall of a retort-setting.

In conclusion, permit me to say that, although I have defined in the above manner some of the proportions to be observed in the construction of retort-settings, I do not put forward my setting as a model, representing the best form of retort-setting, nor do I imagine the proportions given to be the best attainable, or even existent. How wasteful of fuel the present system of setting and heating retorts is, may be perceived when it is said that, although the pyrometric effect of coke is theoretically about 2200° C. (4664° Fahr.), in practice about 1100° C. (2332° Fahr.), or just half this effect, is obtained in retort-settings; and, of the heat produced, not more than half is made use of, for the gases of combustion leave a retort-setting, and escape into the main flue, at a temperature between 500° and 600° C. (1000° to 1200° Fahr.)

Still, so long as no better system of carbonization is known, I believe that much may be done to improve the existing one, by ascertaining and defining the proportions which should be observed in the construction of retort-settings, as well as by inventing new methods of working them; and if I have been enabled to add the smallest quota towards the accomplishment of this end, my purpose will have been attained.

Mr. Wilson said he had not heard the whole of the paper, and could only judge by the diagram and concluding portion that a very important matter had been taken up. The diagram represented a furnace with upper and lower doors—one for firing and one for clinkering—and he supposed the carbonic oxide would be converted at the top of the furnace into carbonic acid. The only question with him was in how far those furnaces were the best for practical use. He found in practice that the seventh retort was an element of weakness, and that a very strong heat in the combustion chamber over the furnace had the effect of quickly burning out the support of that retort, and the other two at the top being dependent upon it, the setting fell down. With six retorts instead of seven, he thought it would be a very successful setting. He had built one which very much resembled it, and had every reason to be satisfied with it, but he had not brought it before the Society, because he did not know how far it would be successful.

The President suggested that Mr. Carpenter's paper (which will appear in next week's Journal) should be read before the discussion was carried further.

(To be continued.)

DEVONPORT GAS COMPANY.

The Annual Meeting of this Company was held last Tuesday—Mr. R. C. Smith in the chair.

The following report was presented:—

The damage caused by the blasting operations to the large gasholder has been repaired with only a temporary limitation of the gas supply, and with little inconvenience to the public.

The extension and renewal of works have been progressing favourably during the year, and a contract has been entered into for erecting a large gasholder and tank, and both will, in all probability, be completed in September next. Other improvements have been carried out, including a new weigh-bridge, a large horizontal condenser in No. 2 store-house, and about 4000 yards of mains and service-pipes have been laid or renewed.

The results attending this year's operations have been very favourable, and the Directors have effected considerable saving by making advantageous contracts for coals.

Notwithstanding the reduction in the price of gas, and the low price of coke, the gross revenue of the year exceeds that of the preceding year.

After payment of the interim dividend, there remains a disposable balance of £2712 5s. 2d., from which it is proposed to pay a dividend of 5 per cent. on the original shares, and 3 per cent. on guaranteed shares, amounting to £2110 16s. 7d., which will leave a balance of £601 8s. 7d. to be carried forward to next account.

Debentures bearing interest at the rate of 4 per cent. per annum have been issued for £4850, to provide for payment of the contracts entered into.

The Directors have much pleasure in reducing the price of gas to 3s. per 1000 cubic feet, commencing with the current quarter, and they propose reducing the price paid for the public lamps, supplied under contract, by the sum of 6s. per lamp.

From the accounts which accompanied the report, it appears that the total capital raised, including debenture bonds to the extent of £11,350, amounted to £58,378, and that there was an available balance of £6622. The account of the working expenses for the past year showed the cost of coals carbonized to have been £7755 17s. 9d., which was somewhat in excess of the amount expended for the same purpose during last year; wages amounted to £1931 2s. 2d.; general repairs, £1245 10s. 6d.; salaries, rates, and taxes, £1495 9s. 2d.; balance, £4131 11s. 1d.; other working expenses, including reserve-fund, interest, lime, cartage, &c., brought the expenditure to a total of £20,042 3s. 2d. The principal items in the income were gas-rental, £14,618 13s. 11d.; rent of meters, £638 13s. 6d.; sale of coke, breeze, and other residuals, £4769 9s. 1d. The net revenue amounted to £6933 18s. 4d.

The Chairman, in moving the adoption of the report, said that although the Shareholders would find a material difference in the working expenses of last year as compared with the previous one, the net results were very nearly equal. The increased quantity of coal that had been consumed last year resulted from the very large increase in the quantity of gas manufactured, which was the largest amount that had ever been produced in the town. The increase of the machinery, &c., to meet this large supply of gas was another cause of the additional expenditure. Their Engineer and Manager were inventive men, and they were continually devising improvements in the machinery for the manufacture of gas and extracting the residuals, and they always applied their improvements so as to effect a saving to the Company, and to be in keeping with the age. About this time last year their large gasholder was broken by the falling of a stone, and the gas escaped, but, owing to the energy of the Manager and Officers, it was repaired without any serious inconvenience to the public. They were very unfavourably situated with regard to the consumption of coke and other residuals. Some gas-works were surrounded by manufactories, where the coke was taken as soon as it was made, but that was not the case at Devonport. £1877 had been spent on new works—principally the large gasholder, which would be 80 feet in diameter, 25 feet deep, and have supporting columns 80 feet in height. It would probably be finished in September.

The motion having been seconded, was carried.

Messrs. R. C. Smith and A. G. Clifton were re-elected Directors, Mr. W. Peck being elected in the place of Mr. J. Joll. Mr. W. Mogg was re-elected Auditor.

A vote of thanks to the Chairman, Directors, and Officers brought the meeting to a close.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

As I anticipated in a previous report, a reduction in the Manchester list prices for house fire coals is being made at the close of this month, and a drop of 10d. per ton upon the first and second qualities has been decided upon by the leading firms, whilst in the outside districts alterations are being made in the various classes of fuel to meet the competition which is being encountered from other quarters. In the South-West Lancashire districts there is no material change to notice, so far as the quoted list rates are concerned, but in the actual selling prices of all classes of round coal there is a great want of regularity, as there are considerable stocks held at nearly all the collieries, notwithstanding the general short time which is being worked, and large buyers have no difficulty in purchasing at considerably under the current rates. The better classes of round coal suitable for house fire purposes are very difficult to sell, and gas-making coals still move off but very slowly, as consumers will only enter into contracts at quite low prices. I understand that the Manchester Corporation have secured a contract for ordinary gas coal, delivered at their works, at the extraordinarily low figure of about 6s. 6d. per ton. The average quotations for coal at the pit mouth may be given at about as under:—Best Wigan Arley, 9s. to 10s. per ton; common Arley, 7s. 6d. to 8s. 6d.; Pemberton four-feet, 7s. to 7s. 6d.; ordinary screened gas coal, 6s. 6d. to 7s.; and common round coal for forge and steam purposes, 5s. 6d. to 6s. per ton. Burgy, though still plentiful in the market, is tolerably steady at about 4s. 9d. to 5s. 3d. per ton for good qualities, and slack, which is scarce, is quoted at 3s. 6d. to 4s. per ton, with an upward tendency in prices, some of the collieries announcing advances of 3d. per ton for next month.

The shipping trade continues extremely dull, and orders have to be pushed for at very low figures to secure business.

Although there are more inquiries reported in the market, the iron trade of this district shows no substantial improvement. The demand for present requirements is still very small, and, as a rule, sales for forward delivery can only be made at the present extremely low rates. Quotations are without material change either as regards local or outside brands of pig iron offering in this market. In finished iron rather more business is reported to be doing, but no better prices are being obtained; Lancashire bars delivered into the Manchester district are quoted at £6 to £6 2s. 6d. per ton.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The Durham coal trade has been less by some 3000 chaldrons shipped at the Tyne Dock. The falling off has been mainly in coasting and Baltic business. It would seem as if merchants and gas companies, wherever it were possible to do so, have taken advantage of the very low prices at which coals have been offered in the open market, and have made up their stocks. At any rate, at the present time, and during the past month, the coasting orders in the market have been extremely limited. The best gas collieries continue to do very well—that is, the bulk of them work full time. Of course, they cannot go beyond that. There is not so much gas coal shipping to the United States of America this year as last; but, as steamers freights are so exceedingly low, many gas companies, who, in other times, might have bought coals nearer home, continue to make purchases of best Durham gas coals. The steam collieries in the North of England, upon the whole, are doing a little better. For the next six weeks, or not at all, Baltic merchants will have to lay in stock for the fall of the year, and as freights to that sea for steamers and sailing ships were never lower than they are at present, merchants have the choice of the market, as a few hundreds extra miles of carrying will be imperceptible in the freight. House coals are low. Any quantity of the best Tyne house coals may be had free on board ship at 9s. 6d. per ton.

The freights in the coasting coal trade are pretty much unaltered from the previous week. The figure for steamers to load coals to London is 4s. per ton; sailing ships to discharge at the wharves, 5s. per ton. There are plenty of vessels offering at these figures. Rates are equally low to the East Coast and British Channel; they were down last week from 10s. to £1 per keel to the nearer ports of Europe. Recent political events in Europe are having no impression upon the freight market one way or the other. If we have a good corn harvest in this country—of which there is every prospect—the figures for the autumn will not be in excess of the present quotations. There is little or nothing doing in the shipment of goods to the Continent. The business done with Germany is extremely limited, and is made up of small parcels. There is not much doing in fire-clay goods thence and homeward to the Tyne and Wear. The mining timber trade is without animation. The iron trade of the North of England is stronger, apparently; there are better shipments of pig and manufactured iron. The Elswick Iron-Works are sending over 1000 tons of machinery off to Bombay. A good few metal water and gas pipes have been shipped abroad within the month from this district. There have been larger shipments of lead from Spain recently, with the prospect of a good deal more coming to hand, as the Spanish trade seems to be reviving. Cargoes of coke have been sent from the Tyne to the Mediterranean.

The chemical trade of the North was not quite so firm last week; prices had a slight tendency downwards.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

A movement is being energetically pushed in the town of Greenlaw, in Berwickshire, for the purpose of introducing lighting by gas, for up to the present, strange to say, the town has been entirely without that civilizing agent. On Friday week a public meeting was held in order to ventilate the subject. The meeting entered heartily into the spirit of the proposed undertaking, which, it is expected, will soon prove quite successful.

After "hanging fire" for a long while, the necessary final steps for the acquisition of the local gas-works by the Johnstone Police Commissioners, under the Burghs Gas Supply (Scotland) Act, have now been resolved upon. The efforts to acquire the works and plant by private arrangement have not been successful. The sum of £18,000 was offered by the Police Commissioners, but the price asked by the Directors of the Gas Company was £25,000, which they subsequently reduced to £20,000. As the Commissioners were not disposed to go that length, they determined upon completing the bargain by arbitration, and chose Mr. Brodie, of Paisley, as their arbiter, Mr. Green, of Preston, being selected by the Gas Company as their arbiter. Those two gentlemen have now appointed Dr. Anderson Kirkwood, an eminent legal authority in Glasgow, as the oversman in the arbitration, and it is expected that the final settlement of the question will soon be announced.

A special meeting of the Falkirk Joint-Stock Gas Company was lately held, at which it was unanimously resolved to offer for the works of the Falkirk Gas Company the sum of £7500, if that Company agreed to expose their works for public sale at that price. The Chairman of the meeting pointed out the desirability, not only for the Shareholders, but for all concerned, of the step that was proposed to be taken, as the Directors were satisfied that, as soon as the purchase was completed, an amount of saving in management and working expenses would be effected to such an extent as to enable the Company to supply the community with gas at a reduction of at least 10d. per 1000 cubic feet. It is stated that there is every prospect of the proposed purchase being speedily carried through.

At the annual meeting of the Paisley Gas Trust, held a few days ago, it was shown that the total revenue for the past year was £26,376 3s., and the surplus £2089 11s., as compared with £3500, the estimated surplus at the beginning of the year. During the year, £1085 worth more gas had been sold than in the preceding year; and since the works had been taken over in 1870, £22,824 of debt had been extinguished. The gas during the year had an illuminating power of 28 to 29 standard candles. If it were reduced to 27 candles, there would be a saving, according to the Provost, of something like 5d. on every 1000 cubic feet, or about £2000 per annum to the town.

One of the Trustees was of opinion that they should have a statement weekly from Dr. Wallace on the quality of the gas. It is proposed to devote £500 of the surplus profits to the purposes of public improvements. The new works at present in progress will cost from £10,000 to £11,000.

On Tuesday, the 23rd inst., a special meeting of the Forfar Gas Commissioners was held, when the subject of purchasing two annuities from a fund provided for redeeming them was discussed; and, subsequently, a discussion took place on the financial state of the Gas Commission. One member was of opinion that the gas had been sold at much less than they had actually been able to do so at; and he said that, instead of having £1800 or £2000 at their credit, they were £80 in debt.

The annual meeting of the Arbroath Gas Corporation was held on Thursday week, when a very interesting report was submitted by Mr. Terrace, the works manager. From the abstract of accounts submitted, it was shown that there was a surplus of £1018 19s. 9d., one-half of which was to go to the Town Council for public improvements, and the other half to the Consumers. The revenue was £10,422 18s. 5d., and the expenditure to £9403 18s. 8d. During the year there had been sold 36,140,000 cubic feet of gas, and the number of consumers was 5128, who paid, on the average, £1 14s. 2d. per annum. A long discussion arose on a proposal to ask for a Provisional Order for the repeal of certain clauses of the Arbroath Gas Act, and for the substitution of clauses authorizing the Corporation to fix the price of gas so as to meet the estimated expenditure, any profits arising to be applied in the reduction of the price of gas to the consumers, and any deficiency to be met by raising the price, and so preventing the need for a rate in aid. It was lost by twelve votes to two, and the price was reduced to 5s. 5d. per 1000 feet, less the rebate of 5d. already resolved upon by the Commissioners.

The pig iron market was much firmer in tone during the past week, and the tendency was decidedly upwards. On Friday afternoon the nominal price was 50s. 1½d. cash, and 50s. 4½d. one month. The stock in the warrant stores is now at 184,202 tons, and there are 96 furnaces in blast, as against 108 at the same time last year. A moderate business is doing in the manufactured iron trade, and most of the mills are going.

No new aspect is showing itself in the coal trade, orders being exceedingly scarce, and procurable in many instances only under the actual cost of production.

SALE OF COMMERCIAL GAS COMPANY'S SHARES.—Last Thursday, at the Mart, Tokenhouse Yard, there was sold £588 10s. of consolidated stock in the Commercial Gas Company, the property of a deceased gentleman. The first lot of £100 sold for £206; the next four lots of £100 each at £200 10s.; while the remaining £88 10s. sold at the rate of £196 per £100 stock. It should be mentioned that the dividend now due for the half year ending the 30th of June last was included in the sale.

FRITH HILL, GODALMING, AND FARNCOMBE WATER COMPANY'S WORKS.—On Monday, the 22nd inst., operations were commenced at this Company's new works at Frith Hill, Godalming, when Mr. Jabez Church, C.E., their Engineer, was present, and the work begun by Messrs. T. Docwra and Son, the Contractors. The Company, with Dr. Haig Brown as chairman, were formed for the purpose of supplying a great want in the district, as no service of water at present exists. They have obtained a Provisional Order from the Board of Trade, under the Gas and Water Facilities Act, 1870, embodying the usual powers, with a nominal capital of £15,000. Before anything was done, trial bore-holes, under the advice of the Engineer, were sunk, when it was proved that an inexhaustible supply of water was to be obtained from the lower greensand. This water was subjected to analysis by several chemists, with excellent results. Dr. Frankland, in his report, says: "It is wholesome, palatable, and of excellent quality for dietetic purposes." There is every reason to believe that the Company have a bright future before them, and Godalming and its neighbourhood are to be congratulated upon the fact that before long the great boon of a constant supply of first-class water will be within the reach of all.

NATIONAL WATER SUPPLY.—The returns asked for by the Society of Arts from the Medical Officers of Health throughout the country as to their water supply are now as complete as it is likely they will be. It was intended that they should all have been sent in and printed for the use of the Conference on Water Supply, held at the request of the Prince of Wales. Such as were ready were then printed and circulated; but many returns have arrived since, and these have been, with the others, issued in the Society's *Journal*, accompanied by a request that any further available information should be communicated. There are now altogether some 106 replies received; and coming as they do from all parts of the country, from towns and rural districts, from manufacturing, agricultural, and mining communities, they give a fair idea of the existing state of water supply. The first question inquired what was the source of supply, and the replies to this are, of course, various; but the great difference in answers to the second question—as to what is the daily amount of supply per head—is astonishing. It ranges from 4½ gallons per day per head up to 40, and in a large number of cases the supply is reported as constant. The lowest supplies mentioned in the returns are—Pudsey, 4½ gallons per head per day; Leigh, 5 (for domestic purposes); Morley, 6; Colne and Marsden, 5 in summer, "very uncertain," and here "notices are up to forbid swilling steps, cleaning windows, &c." Ossett has 10, St. Helen's 12½, Whitby 15; but the majority of returns are from 20 to 30. The replies to the question, "Can you give any information, from your own observation, of sewage-polluted water spreading epidemic diseases?" give useful additional information to the official reports of the Local Government Board. In some cases the spread of typhoid fever is merely referred to as "probably due" to sewage contamination; but there are several in which not only are the cases directly traced to sewage-polluted water, but with a change of water the epidemic has ceased. The returns should be seen by those who have the charge of local sanitary arrangements. Two cases are mentioned of the spread of fever by milk mixed with sewage-polluted water. The attempt to elicit information about the effect of water on health, and the production of diseases not epidemic, has not been so successful; but diarrhœa, dyspepsia, and *malaise* are in many cases referred to. Diphtheria, too, is several times mentioned. The return from Chadderton, near Oldham, gives a good typical instance of the ignorance throughout the country generally on water supply. The Medical Officer found a cesspool near a pump, and asked the farmer what he did with the contents. "Strange to say," he replied, "the cesspool never needs to be cleaned out." The reason is obvious; the excrement in a liquid state filtered into the well, and no one suffered until the outbreak of typhoid epidemic.—*The Times.*

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2893.—THOMPSON, W. P., Liverpool, "Improvements in the generation and production of gas for lighting, heating, and other purposes, and in apparatus therefor." A communication. July 20, 1878.

2908.—CLARK, A. M., Chancery Lane, London, "Improvements in apparatus for exhausting and forcing fluids." A communication. July 20, 1878.

2941.—RAVENOR, R., Speenhamland, Berks, "Improvements in apparatus or appliances for attaching service-pipes to water, gas, or other mains, while under pressure." July 24, 1878.

2942.—JOHNSON, J. H., Lincoln's Inn Fields, London, "Improvements in lamps." A communication. (Complete specification.) July 24, 1878.

2943.—LAKE, W. R., Southampton Buildings, London, "Improvements in lighting or illuminating apparatus, chiefly designed for use in mines, tunnels, and many storeyed buildings." A communication. July 24, 1878.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

390.—MORGAN-BROWN, W., Southampton Buildings, London, "Improvements in steam-pumps for compressing or exhausting air or gases with or without fluids." A communication. Jan. 30, 1878.

453.—WEST, J., Maidstone, Kent, "Improvements in apparatus for charging gas-retorts." Feb. 4, 1878.

780.—AHRBECKER, H. C., Stamford Street, London, "Improvements in meters or apparatus for measuring or ascertaining the flow of fluids, which improvements are also applicable to obtaining motive power." Feb. 25, 1878.

PATENTS WHICH HAVE BECOME VOID.

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2463.—HIGGINSON, A., "Improvements in engines and pumps." July 8, 1875.

2492.—KING, T., "Improvements in direct-acting steam-pumps." July 10, 1875.

2499.—PATRICK, R., jun., "Improvements in rotary pumps and engines." July 12, 1875.

2508.—LAKE, W. R., "An improved liquid-meter." July 12, 1875.

2523.—NEWTON, H. E., "Improvements in apparatus applicable to burners for lighting purposes." July 13, 1875.

2557.—GRAUHAN, F. W., "Improvements in apparatus employed in the filtration of water, sewage, and other fluids." July 17, 1875.

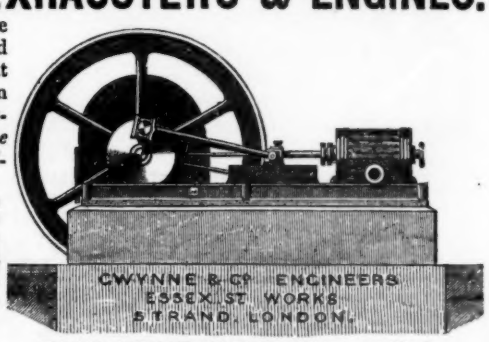
The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, and TWO MEDALS at the PHILADELPHIA EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS; Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

GWYNNE & BEALE'S PATENT GAS-EXHAUSTERS & ENGINES.

EXHAUSTER with Trunk Engine, capable of passing 210,000 cubic feet per hour.

The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

GWYNNE & CO. have made the largest and most perfect Gas-Exhausting Machinery in the world, and have completed Exhausters to the extent of 7,000,000 cubic feet passed per hour, of all sizes from 2000 to 210,000 cubic feet per hour.



52,500 EXHAUSTER, with Horizontal Engine combined.

GWYNNE & CO. do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, *but to produce machinery of the very highest quality, and most approved design and workmanship.* The result is that in every instance their work is giving the fullest satisfaction. Numerous testimonials and references can be given to Companies using their Machinery for years past.

Exhausters, with or without Engines combined, can be made to pass the gas without oscillation or variation in pressure

Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

PLEASE ADDRESS IN FULL, GWYNNE & CO., Hydraulic and Gas Engineers,

ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C., ENGLAND.

Gwynne & Co.'s New Catalogue on Gas-Exhausting and other Machinery may be obtained on application at the above Address.

WANTED immediately, Two Stokers for a small Gas-Works. Wages 25s. per week.
Applications, with reference, to MANAGER, Gas-Works, SLOUGH.

WANTED, Readers of the Pamphlet, "Cooking and Heating by Gas;" on Burners, &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, Gas-Works, SYDENHAM, S.E.

WANTED, near London, a Meter In-SPECTOR. Will not be required to do Fitting or Service Laying. Wages 30s. per week.
Apply, by letter, to No. 483, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Advertiser, a Situa-tion as Working Manager, Clerk, Collector, or Inspector. No objection to go abroad.
Address No. 482, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, New or Second-hand, an ENGINE and EXHAUSTER, with or without Boiler combined, for Gas-Works making about 56,000 cubic feet of Gas in the 24 hours.
Particulars as to price, capacity, &c., to be sent to J. MEARNS, Gas-Works, Banbridge, IRELAND.

WANTED, a Manager to take charge of small Gas-Works in the country. Must be well up in the Manufacture and Distribution of Gas, taking Meters, &c.
Apply, by letter, to Mr. GEORGE CHISLETT, Wimborne, DORSET.

WANTED, the Management or Assist-ant Management of a Gas-Works. Thoroughly competent in every branch of the profession. First-class testimonials and references.
Address E. ELLIOTT, 277, Tabard Street, Borough, LONDON, S.E.

WANTED, immediately, for South Wales, an efficient GAS-FITTER. Must be experienced, and able to repair and take indexes of meters.
State wages required, experience, and references to No. 477, care of Mr. King, 11, Bolt Court, Fleet Street, LONDON, E.C.

TO GAS COMPANIES AND GAS ENGINEERS.

WANTED, by the Advertiser, a Situa-tion as WORKING MANAGER or MANAGER of Gas-Works. Has been in present situation nearly four years. Thoroughly competent in every branch of the profession. First-class testimonials and references.
Address No. 481, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by Samuel Thompson & Co., Colliery Office, Lancaster, APPLICATION for PRICES from Gas Managers who are prepared to receive Tenders for GAS COAL or CANNEL.
John Leigh, Esq., M.R.C.S., F.C.S., &c., &c., in his analytical report of S. T. & Co.'s Coal, says: "It is remarkable for its purity, I have scarcely ever examined a Coal containing so small a quantity of ash, and when Cannel of the best description is scarce, it may well replace this material."

WANTED, for a small Gas-Works, a good steady Man as STOKER. One able to do smith's work preferred. Constant job to a suitable man. Wages 28s. per week, overtime paid. None need apply whose character will not bear investigation.
Apply to W. F. BROADBERRY, Gas-Works, SOUTHEND-ON-SEA.

WANTED, by the Advertiser, a Situa-tion as MANAGER in a small Gas-Work. Understands Main and Service Laying, Gas-Fitting, Internal Fitting, and Retort-Setting. Twelve years good character.
Apply to Mr. ARTHUR BROADBERY, Ramsey, HUNTINGDONSHIRE.

SHEFFIELD UNITED GASLIGHT COMPANY.

WANTED, by the above Company, an Energetic and Experienced Resident SUPERINTENDENT, to take charge of a Gas Station capable of producing 4 million cubic feet per day.
He must thoroughly understand the manufacture and distribution of gas.
Applications, stating age, salary, and other qualifications, to Mr. T. ROBERTS, Chief Manager.
Offices, Commercial Street, July 24, 1878.

WANTED immediately, a thoroughly competent GAS ENGINEER, for Works situated in an exceptionally healthy British Colony. Must be a man of mature judgment and experience, thoroughly conversant with the principles and details of the Manufacture and Distribution of Gas, and professionally qualified for designing and practically superintending the construction of all Works necessary for those purposes.
Present make about 300 millions a year, and rapidly increasing.
To a thoroughly competent man a liberal salary would be given, and the situation would be a permanent and improving one.
Application to be made by letter only (in first instance), stating age and experience, and enclosing copies of testimonials, which will not be returned.
Address No. 479, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Advertiser is desirous of meeting with an Appointment as MANAGER or ASSISTANT MANAGER of a Gas-Works. Has had the charge of a works where the annual make was 90 million cubic feet of gas.
Copies of testimonials on application to JOHN HENRY LYON, 24, Park Street, MACCLESFIELD.

GAS ENGINEER.

A Provincial Gas Company require the services of a fully qualified person, thoroughly experienced in the Manufacture and Distribution of Gas, to act as SUPERINTENDENT of their Works, under the direction of the Managing Director. The annual make of gas is over 200 million cubic feet.
Applications, stating age and salary required, with copies of testimonials, to be addressed to No. 480, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

HENRY LYON (14 years Engineer and Manager of the largest of the Manchester Corporation Gas-Works) Mechanical and Consulting Gas Engineer, reports upon the condition and value of Gas-Works, supplies plans and specifications of all Apparatus appertaining to Gas-Works, and re-models existing Works.
Address Brooklyn, near Halliwell Lane, Cheetham Hill Road, MANCHESTER.

A BARGAIN.

FOR SALE—Seven New Iron Retorts, 7 ft. 6 in. long by 13½ in. by 12½ in. Weight, 18 cwt.
Apply to the MANAGER, Gas-Works, St. Neots, HUNTS.

FOR SALE – One 50 ft. by 14 ft. Gas-HOLDER, nearly new, with Columns and Girders. Price £225, a bargain.
Also a STATION-METER, in good working order, to pass 15 000 feet per hour; and Four 10 ft. PURIFIERS with Hydraulic Centre-Valve.
Apply to J. S. REEVES, Manager, Gas-Works, BILSTON.

ON SALE—A Station-Meter (with new Drum), capable of passing 10,000 cubic feet per hour, with Hydraulic Valves, Bye-Pass, &c.; 10-in. Connections. Has been removed to make room for one of larger capacity.
For particulars and price, apply to GEORGE NEWTON, Gas-Meter Manufacturer, Union Street West, OLDHAM.

STATION-METER FOR SALE, with 8-day Clock, Tell-Tale, Water-Level, Pressure-Gauge, Hydraulic Valves, and Bye-Pass, in square case. Size, 6 ft. 3 in. by 6 ft. 3 in., of a neat pattern, in good working order, able to pass 8000 feet per hour. Parted with in consequence of being replaced by a larger one.
Apply to P. WATSON, Gas-Works, STIRLING.

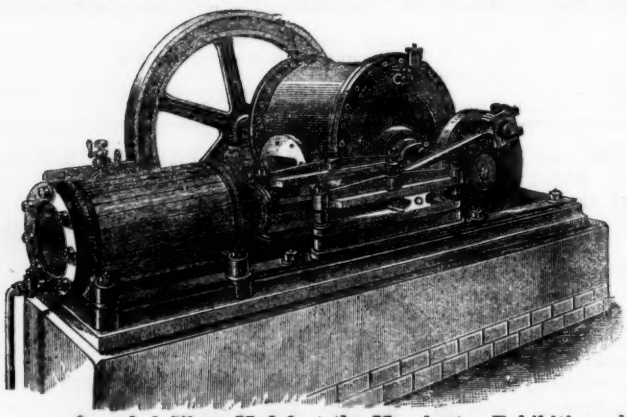
GAS-WORKS FOR SALE, with Iron Gasholder-Tank, suitable for 500 lights; packed and marked ready for erection. A countermanded order, and will be sold cheap.
Also Two Purifiers, 6 ft. 6 in. by 4 ft. 6 in. by 3 ft. 6 in. deep, with Lifting Gear, Sieves, Covers, and 6 in. Connections complete. Price, in truck, £55.
Also a combined Engine and Exhauster, with Valves complete, by Waller and Co., to pass 5000 cubic feet per hour. Price, in truck, £40.
Address No. 484, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—The Newent Gas-Works, consisting of Retort-House, with bed of three and two beds of two retorts; Meter-House and Station-Meter; Purifying-House and two Purifiers; Lime and Store Sheds; Condensers; and Gasholder to contain about 5000 cubic feet; Manager's House and Office, all enclosed, together with the Mains throughout the town, Street-Lamps, Posts, Fittings, and Consumers Meters.
The average make of Gas is about 1,500,000 cubic feet per annum; price, 8s.; and the consumption is steadily increasing. A line of railway will shortly be open, and there is a coal-works within two miles of the town.
For further particulars, apply by letter, addressed E. E., 61, Portsdown Road, Maida Vale, LONDON.

GRAND JUNCTION WATER-WORKS COMPANY.

THE Court of Directors are prepared to receive TENDERS for the Construction of a STORAGE RESERVOIR, at their Hampton Works.
Copies of the drawings and specification may be obtained, on payment of Two Guineas, at the Company's Offices, 65, South Molton Street, W.; and tenders must be sent in, sealed and addressed to the Court of Directors, on or before Wednesday, the 14th day of August next, to be delivered at the above Office not later than Ten o'clock a.m. on that day.
The Directors do not bind themselves to accept the lowest or any tender.
By order,
E. O. COE, Esq., Secretary.
65, South Molton Street, July 17, 1878.

BEALE'S IMPROVED PATENT GAS EXHAUSTERS



WITH

Wrought-Iron Spindles and

ENGINES COMBINED.

SOLE MAKERS,

GEORGE WALLER & CO.

MAKERS OF ENGINES, EXHAUSTERS, INDEX AND DISC GAS-VALVES, HYDRAULIC MAIN VALVES, BYE-PASS VALVES, TAR, LIQUOR, AND OTHER PUMPS, SCRUBBERS AND PURIFIERS, CONDENSERS, BOILERS, &c.

Awarded Silver Medal at the Manchester Exhibition of the Society for the Promotion of Scientific Industry.

Phœnix Engineering Works:

HOLLAND STREET, SOUTHWARK, S.E.

TO GAS ENGINEERS.

D. BRUCE PEEBLES & CO.

Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

TAY WORKS, BONNINGTON, EDINBURGH.

TO TAR DISTILLERS.

THE Atherton Local Board invite TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR to be produced at their Gas-Works during a period of One, Two, or Three years from the 1st of September next.

Further information may be obtained from the undersigned, to whom tenders should be addressed not later than Monday, Aug. 5.

By order,
DANIEL SCHOFIELD, Clerk.
Atherton, near Manchester, July 15, 1878.

THE Directors of the Waltham Abbey and Cheshunt Gas Company are prepared to receive TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works for the year ending Aug. 1, 1879.

Estimated quantity, 20,000 gallons of Tar, and 60,000 gallons of Liquor.

Tenders, endorsed "Tender for Tar and Liquor," to be delivered on or before Thursday, the 1st prox., at the Offices of the Company, Waltham Cross, Herts, where further particulars can be obtained on application.

By order,
H. TOWNSEND, Manager.

MANCHESTER CORPORATION GAS-WORKS.

AMMONIACAL LIQUOR.

THE Gas Committee of the Corporation of Manchester are prepared to receive TENDERS for the Purchase of the AMMONIACAL LIQUOR to be produced at their Gaythorn and Rochdale Road Works during a period of One or more years, commencing from the 1st day of January, 1880.

In addition to tenders for the purchase of the Liquor in its crude state, the Committee will also be prepared to consider TENDERS for its DISPOSAL, either by manufacture into Sulphate of Ammonia at the above-mentioned Works on their behalf, or in any other manner.

The Committee reserve to themselves the option of accepting the offer, the terms of which they may deem most advantageous.

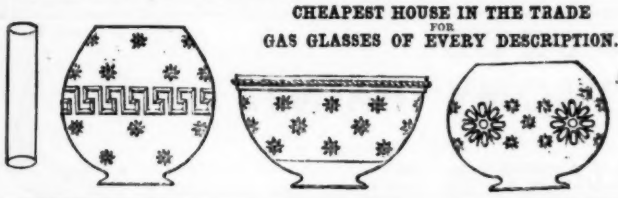
They do not bind themselves to accept the highest or any tender.

Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Ammoniacal Liquor," must be delivered at these Offices, on or before Tuesday, the 1st day of October next.

Forms of tender and further particulars can be obtained on application to Mr. George B. Jackson, at the Gas Offices. By order of the Gas Committee,
JOSEPH HERON, Town Clerk.
Town Hall, Manchester, May 31, 1878.

COMMERCIAL GLASS WORKS, 27, WELLCLOSE SQUARE, LONDON, E.

CHEAPEST HOUSE IN THE TRADE
FOR
GAS GLASSES OF EVERY DESCRIPTION.



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AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

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DIRECT FROM THE

MARQUESS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

For Prices and Particulars, apply to

MR. S. J. DITCHFIELD,

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THE THAMES BANK IRON COMPANY,

(Successors to LYNCH WHITE,)

SUPPLY FROM STOCK

CAST-IRON RETORTS, SOCKET-PIPES for GAS or WATER PURPOSES, FLANGE-PIPES for STEAM, RAIN-WATER PIPES and GUTTERS, HOT-WATER PIPES and BOILERS, and all requisite Connexions for same; also LAMP-COLUMNS, LAMPS, WROUGHT FRAMES, WROUGHT-IRON TUBING, &c., &c.

All kinds of Gas-Works Apparatus and General Castings made to Pattern or Drawing.

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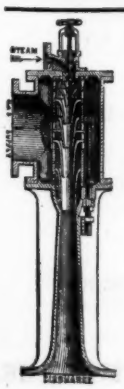

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FOR PARTICULARS, APPLY TO

KÖRTING BROS.,

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OR TO

GERALD J. TUPP, 8, John Street, Adelphi, W.C., LONDON,

SOLE AGENT FOR ENGLAND AND WALES.

THE BROMLEY GAS CONSUMERS COMPANY.

NOTICE is hereby given that an EXTRAORDINARY GENERAL MEETING of the Shareholders of this Company will be held at the Bell Hotel, Bromley, Kent, on Tuesday, the 13th day of August next, to authorize the Directors to pay an interim dividend for the half year ending the 30th of June last. And also to authorize the Directors to apply to Parliament in the ensuing session for an Act to empower the Company to raise additional capital and for other purposes.

The chair will be taken at six o'clock precisely.

By order,
GEORGE H. OSBORN, Secretary and Manager.
Offices and Works, Brick Kiln Lane,
Bromley, Kent, July 30, 1878.

THE Directors of the Clayton, Allerton, and Thornton Gas Company are prepared to receive TENDERS for the Supply of 3000 Tons of GAS COAL, GAS NUTS, and CANNEL COAL, well screened, and free from scale and sulphurous pyrites, in such quantities as the Manager may, from time to time, direct, delivered at their Gas-Works, Low Lane, Clayton, or at the Great Northern Railway Station, Clayton, during the year ending Aug. 31, 1879.

Tenderers to state the name of the pits from which they purpose to raise the coal.

Sealed tenders, endorsed "Tender for Gas Coal," addressed to the Chairman at the Gas-Works, to be delivered on or before Monday, the 12th of August next.

The Directors do not pledge themselves to accept the lowest or any tender, reserving to themselves the right to divide the contract as they may think proper.

By order,
JOHN NIVEN, Manager.
Gas Office, Clayton, near Bradford, July 9, 1878.

GOSPORT GAS-WORKS.

CONTRACT NO. 3.
TO CONTRACTORS.

THE Directors of the Gosport Gas and Coke Company are prepared to receive TENDERS for the Construction of a PURIFYING HOUSE, LIME HOUSE, and other Works connected therewith, at their Gas-Works at Gosport.

Drawings and specifications may be inspected, and forms of tender and schedules of quantities may be obtained, at the Offices of the Company at Gosport, and at the Office of Messrs. Thomas and Charles Hawksley, Civil Engineers, 30, Great George Street, Westminster, S.W., on and after the 26th day of July inst., and tenders must be delivered at the Offices of the Company on or before the 13th day of August next.

The Company do not pledge themselves to accept the lowest or other tender.

By order,
HENRY COMPIGNÉ,
Secretary and Treasurer.
Gosport, July 24, 1878.

GOSPORT GAS-WORKS.

CONTRACTS NOS. 4 & 5.

CONTRACTS FOR IRON ROOFS, PURIFIERS, AND OTHER CAST AND WROUGHT IRON MATERIALS AND APPARATUS.

THE Directors of the Gosport Gas and Coke Company are prepared to receive TENDERS for the Construction and Erection of certain Iron Roofs, Purifiers, Central Valve, Traveller, and other Cast and Wrought Iron Materials and Apparatus required for the extension of their Gas-Works at Gosport.

Drawings may be seen, and specification and form of tender may be obtained, on application at the Offices of the Company at Gosport, and at the Office of Messrs. Thomas and Charles Hawksley, Civil Engineers, 30, Great George Street, Westminster, S.W., on and after the 26th day of July inst., and tenders must be delivered at the Offices of the Company on or before the 13th day of August next.

The Company do not pledge themselves to accept the lowest or other tender.

By order,
HENRY COMPIGNÉ,
Secretary and Treasurer.
Gosport, July 24, 1878.

A PAMPHLET ON DIP-PIPES, &c., post free 6½d., on application to W. WHITE, Gas-Works, Abersychan, MON. See Reviews in the *Gas Trade Circular and Review*, March 29, 1878, and *Design and Work*, March 30, 1878.

Now ready, revised and considerably enlarged, price 5s.

THE TRANSFER OF GAS-WORKS TO LOCAL AUTHORITIES. The latest statistics and analyses of working under Municipal Management, 1868-78, with the London Gas Supply, 1878, by ARTHUR SILVERTHORNE, Consulting Engineer.

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ANALYSES OF SCOTCH COALS, CANNEL, SPLINT, SHALE, &c., USED in the MANUFACTURE of GAS. By WILLIAM WALLACE, Ph. D., F.R.S.E., F.C.S., &c., Public Analyst and Gas Examiner for the City of Glasgow.

LONDON: W. B. KING,
11, BOLT COURT, FLEET STREET, E.C.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

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ON THE

SCIENCE AND PRACTICE OF THE MANUFACTURE & DISTRIBUTION

OF

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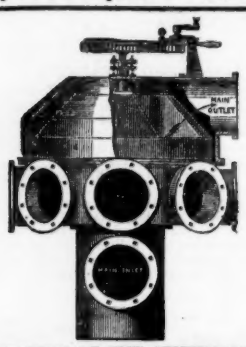
It does not require DRIERS like other Paints.

It does not poison the painter like white lead. No colic by its use.

It has greater durability in colour, as sulphurous gases do not blacken it as they do white lead.

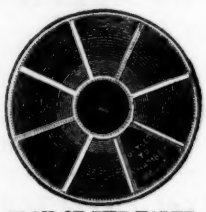
It is of a light stone colour, and has a body equal to white lead, and as its specific gravity is so much less, it covers equally well one-third more surface, by which a great saving is effected; a similar economy arises from its use in steam and gas joints, for which purpose it is superior to white lead.



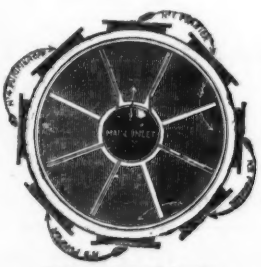
ELEVATION OF THE CENTRE-VALVE.

C. & W. WALKERS'

PATENT CENTRE-VALVES.



PLAN OF THE VALVE.



PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS, DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

THE

STANDARD WASHER AND SCRUBBER.

[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]

Some of the advantages claimed for this Apparatus are as follow:—

The Exposing of a large Amount of Effectually-wetted Surface (which is continually reproduced) to act upon the Gas.

Unerring Regularity in the Distribution of the Liquor.

Saving of Expense in Providing and Exchanging Scrubbing Material—none being required.

Economy of Space, thus enabling the Apparatus to be protected from the Weather.

Economy of First Cost and of Maintenance.

It works without Pressure.

It is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured.

Applications for Prices, &c., to be made to

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ECONOMY IN THE PRODUCTION OF GAS.

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For Jointing and Repairing Retorts and Ovens *in* action and *out* of action.

A Pamphlet on the advantages of the above, with modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

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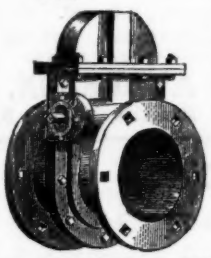
WITH WROUGHT-IRON PINIONS.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are proved on both sides to 30 lbs. on the square inch before leaving the works, and are kept in stock.

In ordering Valves, please state whether required for under or above ground, and if to be with flanges or spigots and sockets cast on, or with separate spigot and socket pieces.

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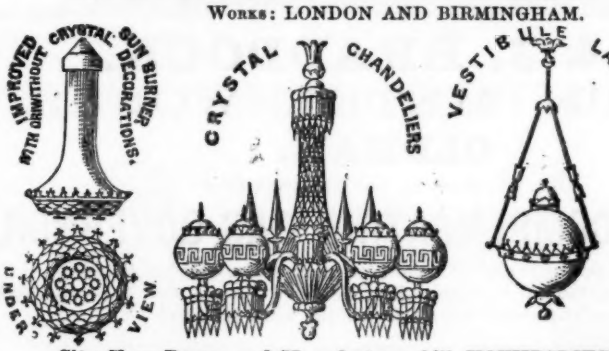

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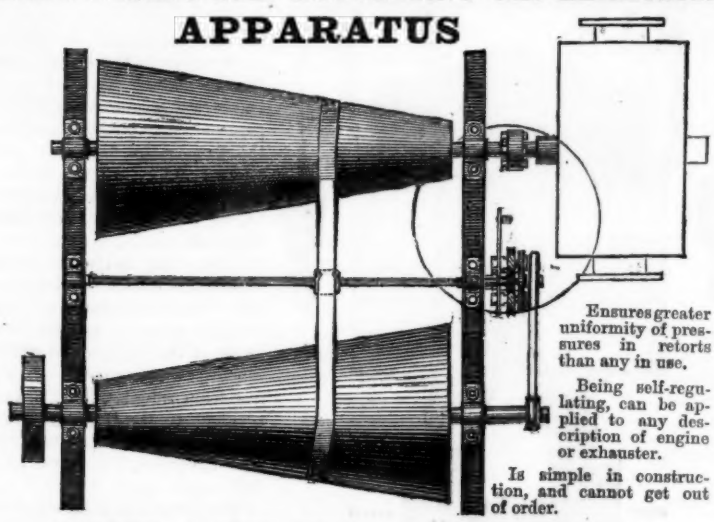

Ensures greater uniformity of pressures in retorts than any in use.

Being self-regulating, can be applied to any description of engine or exhauster.

Is simple in construction, and cannot get out of order.

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Full Particulars, Testimonials, Descriptive Circulars, Estimates, &c., on application.

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THE LAW UNION FIRE AND LIFE INSURANCE COMPANY, of No. 126, Chancery Lane, London, grants Policies of Insurance on Gas-Works, and Buildings connected therewith, which cover risk of explosion and spontaneous ignition of Coal, on very advantageous terms. Full particulars will be sent post free on application to

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CATHELS'S Patent District Dry Gas-GOVERNOR is the only perfect self-acting contrivance for Regulating the Pressures in the higher levels of a district.

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Coloured lithograph copies of Working Drawings of Beds of One to Seven Retorts (so clearly arranged and fully shown as to be easily understood by any retort setter or bricklayer) having been made of these valuable settings, they can now be supplied with detailed Specification immediately on receipt of orders.

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GAS COAL COLLIERIES, NEAR WREXHAM,

Are prepared to Supply their excellent GAS COAL on very favourable terms.

This Coal yields more than 10,000 cubic feet per Ton of gas of good quality, *in practical working on the large scale.*

A large purchaser reports the coke to be clear, of a quality rarely equalled in the retort-furnace, and much liked by the stokers.

DEAN'S PRIMROSE GAS COALS.

South Metropolitan Gaslight and Coke Company, London, July 12, 1878.

The Owners of the Dean's Primrose Colliery.

Dear Sirs,—I have much pleasure in stating that this Company have regularly used your Coals for more than thirty years, and that in all essential particulars they give the most satisfactory results.

The yield of Gas is from 9700 to 9800 feet per ton, of full 16 candles illuminating power, tested by the London Referees Standard Burner; and the Coke is of very good quality, while the quantity is about 40 bushels to the ton of Coal.

I consider Dean's Primrose Coals to rank amongst the first-class Gas Coals from the Durham Coal-Field.

Yours truly, GEORGE LIVESEY.

These Coals are also used by The Gaslight and Coke Company (London), and other English and Foreign Gas Companies.

Steamers loaded with quick despatch in the River Tyne. Price and other terms on application at the

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Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

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Public Accountant,

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BUYERS OF COAL TAR,

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AMMONIACAL LIQUOR, &c.

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G. A. BAILEY AND CO.,

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GRIRDROD'S PATENT

PORTABLE PIPE SCREWING MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

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Brassfounders, Gauge Injector and Tool Makers,

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GREAT SAVING OF LABOUR.

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PORTABLE DRILLING-MACHINE,

Now in use by all the Principal Gas and Water Companies in the United Kingdom.

E Size, for Services in Pipes, 2 to 3 in. bore	£3 10 0
F Size, for Services in Pipes, 2 to 4 in. bore	4 0 0
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Drills, 1s. 6d. each.

Machines sent on approval, if desired.

Prices for other Sizes and Modifications, with full Particulars and Testimonials, on application to

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BAILES & HALLSWORTH,

CONTRACTORS FOR THE

PURIFICATION OF COAL GAS

BY THEIR

PATENT HYDRATED PEROXIDE OF IRON MATERIAL.

The Material is adapted specially for taking up sulphuretted hydrogen, and will simultaneously absorb any ammonia that may pass the scrubbers.

The spent oxide resulting from our Material is more valuable than that from natural oxide of iron, and manufacturing chemists buy it in preference.

The Material has now been in use during the past three years in most of the principal Gas-Works in Yorkshire and elsewhere.

It contains considerably less moisture than natural oxide of iron, and is much cheaper and more efficient as a purifying agent.

B. & H. are purchasers of Spent Oxide, or will take Spent in exchange for New Material.

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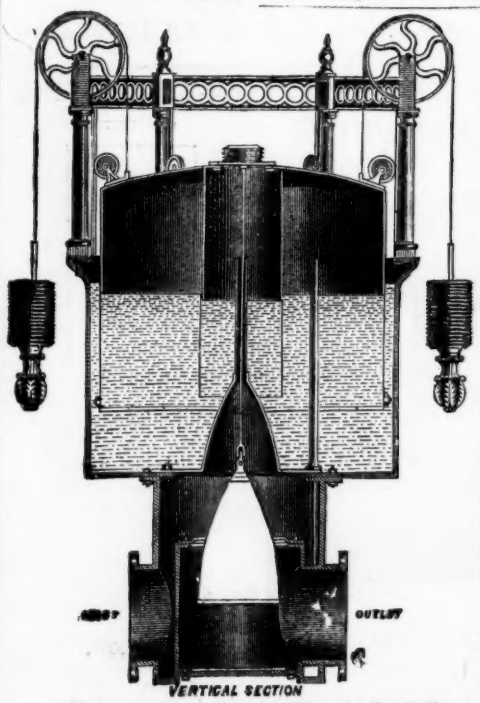
GLOBE METER-WORKS,

OLDHAM,

Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

F. & C. OSLER,

45, OXFORD STREET, LONDON, W.

MANUFACTORY AND SHOW-ROOMS:

BROAD STREET, BIRMINGHAM.

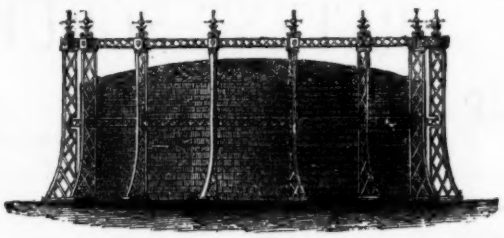
ESTABLISHED 1807.

MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS.

WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

LONDON OFFICE:

6, WESTMINSTER CHAMBERS, VICTORIA STREET,

GAS ENGINEERS, IRONFOUNDERS, &c.,

MANUFACTURERS OF

GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED LAMP-POSTS, PIPES,

AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

MANN & OWENS' PATENT GAS-VALVE.

EVERY VALVE WARRANTED TO BE PERFECTLY SOUND AND GAS-TIGHT.

VALVE, with Indicator or Above Ground. UNDERGROUND VALVE.

The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.

The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.

The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

SOLE MANUFACTURERS:

S. OWENS AND CO.,

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WHITEFRIARS STREET, LONDON, E.C.

PRICES, SIZES, AND FULL PARTICULARS ON APPLICATION.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

CHARLES HORSLEY, Agent.

THE

SILICA FIRE-BRICK CO.,

OUGHTIBRIDGE

Near SHEFFIELD,

Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces, and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

TROTTER, HAINES, & CORBETT,

BRETTELL'S ESTATE

FIRE CLAY & BRICK WORKS,

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Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

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Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

Of every kind.

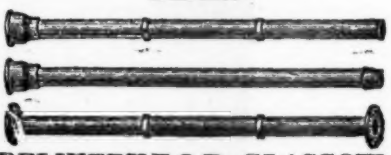
The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture.

GAS AND WATER PIPES.

WILLIAM MACLEOD & CO.,

23 & 25, OSWALD STREET, GLASGOW.

CAST-IRON GAS AND WATER PIPES.



DELIVERY F.O.B., GLASGOW.

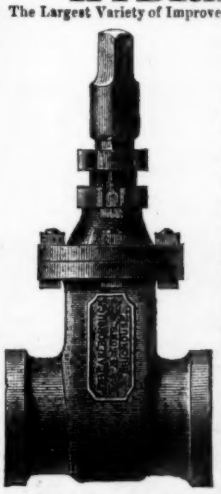
Prices on application.

SLUICE VALVES.

The STRONGEST, CHEAPEST, & BEST in the TRADE.

HYDRANTS.

The Largest Variety of Improved Designs in the Market.



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SLUICE VALVES for Water.
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RESERVOIR SLUICES
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BALL VALVES.
Compound HYDRANTS.
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HOSE UNIONS and REELS.
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SCREW COCKS and FERRULES.

Tested with 600 to 900 feet head of pressure.

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COMMERCIAL BRASS AND IRON WORKS, } BRIGHOUSE,
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Contractors to the British and Indian Governments.

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Where Samples may be seen.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im- portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

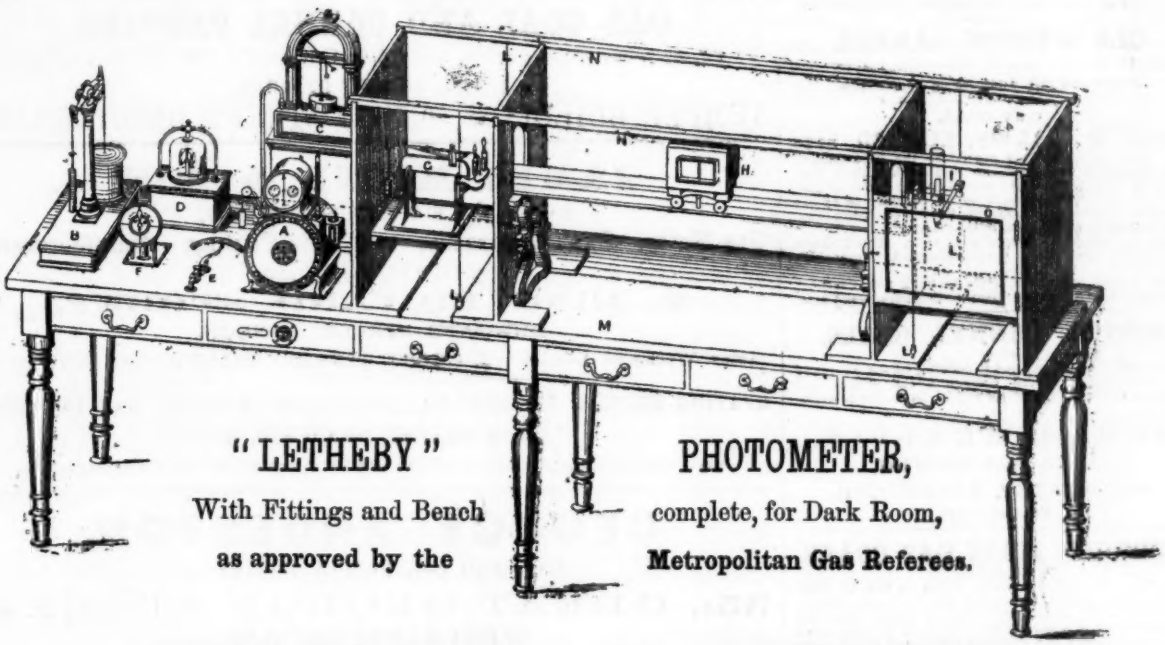
They contain their own engine power, re- quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

WILLIAM SUGG,

GAS ENGINEER,

VINCENT WORKS, WESTMINSTER, S.W.



"LETHEBY" PHOTOMETER,

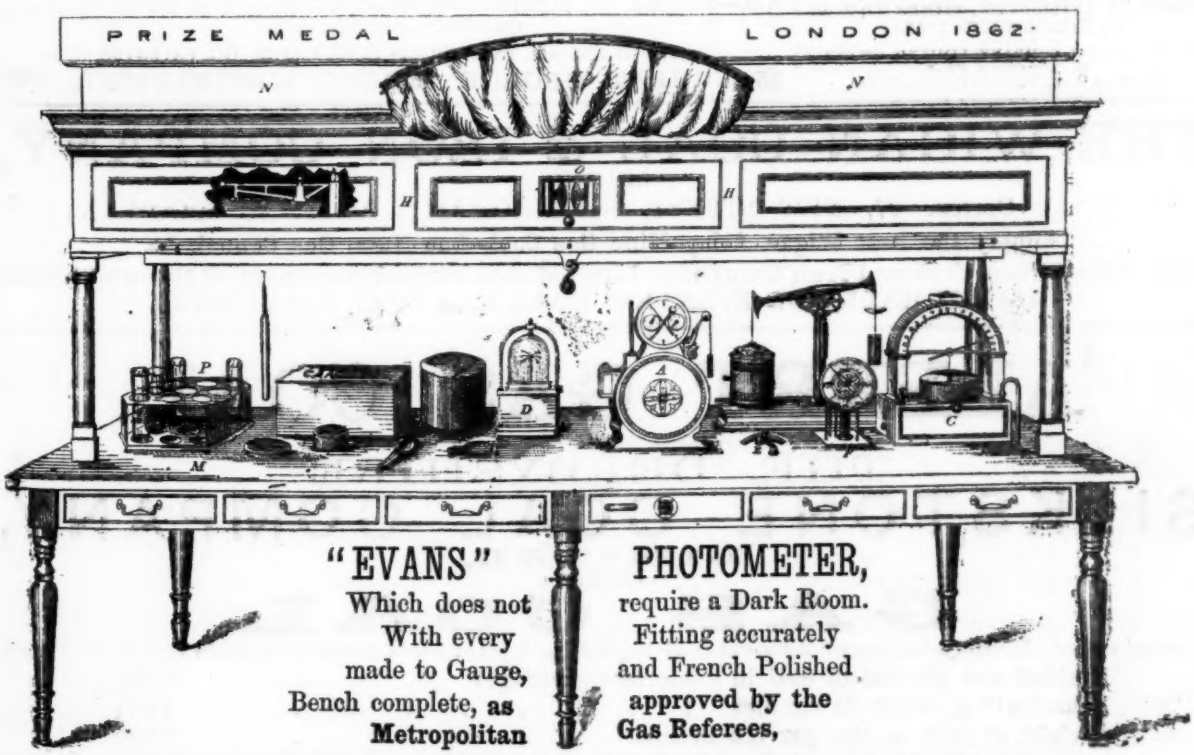
With Fittings and Bench complete, for Dark Room,

as approved by the Metropolitan Gas Referees.

IMPROVED LOWE'S JET PHOTOMETER.

WILLIAM SUGG'S PATENT ILLUMINATING POWER METER.

All Kinds of Gas-Testing Apparatus of the most approved forms.



"EVANS" PHOTOMETER,

Which does not require a Dark Room.

With every Fitting accurately made to Gauge, and French Polished Bench complete, as approved by the Metropolitan Gas Referees,

And as supplied and fixed by me at the Metropolitan Testing-Stations.

Price Lists and all Particulars on application.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

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SHOTT'S BOGHEAD.

LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

Prices and full Analyses on application.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over 10,000 cubic feet of gas, with an illuminating power of 16 candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

Established 1840.

HEBBURN MAIN GAS COALS.

T. Stone, Esq., of Weymouth, writes on Nov. 17, 1876: "I have used about 12,000 tons of this Coal, with, I think, the best possible results, although not always under the most favourable circumstances. My Coal account made up to Midsummer last showed a makeage of 10,594 cubic feet per ton of 14½-candle gas, and not a hundredweight of Cannel used. This statement would, I know, be incredible to many men, and may provoke the remark, 'How much of it is paid for?' For the gratification of such, I have to say that, of the above quantity, 9866 cubic feet per ton of Coal carbonized were brought to charge and duly paid for, with the exception of about 6s. per cent. for bad debts. The coke is of excellent quality. The above facts I hold to be a greater recommendation to your Coal than any words of mine could be."

PRICES ON APPLICATION, EITHER F.O.B. OR BY RAIL IN TRUCK LOADS.

THE TYNE COAL COMPANY, LIMITED, OWNERS.
W. RICHARDSON, Fitter,
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FERRAND DAVIES,

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AGENT FOR

THOMAS BARR'S LESMAHAGOW MAIN CANNEL,

AND

NEWTON, CHAMBERS, & CO.'S SILKSTONE GAS COALS.

Analyses and Quotations on application.

WILSON CARTER AND PEARSON,

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Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.

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Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

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STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

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GAS AND CONSULTING ENGINEER,

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PATENTEE and MANUFACTURER of the following Invention

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES, WASHERS, SCRUBBERS.

FUEL-MACHINE, for Compressing Breeze and Tar.

N.B.—Pamphlet, with Eighteen Illustrations and Letterpress on the Construction of Gas-Works, post free, 2s. 6d.

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THE WIGAN COAL & IRON COMPANY,

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DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN;

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

ALBERT GAS COAL.

THE DERBYSHIRE SILKSTONE COAL COMPANY,

LIMITED,

CAN OFFER A

GAS COAL

Of superior quality, delivered in trucks at any Railway Station in England, or shipped on board at Hull, Grimsby Docks, or Barrow-in-Furness.

Purified gas per ton of coal in cubic feet (average)	10,775
Illuminating power in candles	14·71
Weight of coke in lbs. per ton of coal	1,502

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12.240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

HYDRATED PURIFYING MATERIAL.

Samples on application.

MESSRS. SPENCE BROS., LIMITED,

Will be glad to supply the above on the most favourable terms,

And to treat, by Purchase or Exchange, for Spent Oxide.

PRICES ON APPLICATION.

ALSO PATENT DRY COPPERAS FOR EXTRACTING AMMONIA.

VICTORIA CHEMICAL WORKS, BRADFORD, NEAR MANCHESTER.

Established

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THE ORIGINAL
WORTLEY FIRE-BRICK WORKS,
NEAR LEEDS,

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SPECIAL NOTICE.—Our Patent Machine-made Retorts have now been in *actual work* nearly 1000 days, and are yet in good order. References on application.
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THORNCLIFFE IRON-WORKS AND COLLIERIES,

NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"Warrington Gaslight and Coke Company,
Offices, Mersey Street, Warrington, April 23, 1877.

"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.

CROLL'S
DRY GAS-METERS,

PRIZE MEDALS.
LONDON, 1851;
NEW YORK, 1853
PARIS, 1855.

(INVENTED & PATENTED IN 1844,)

COMBINING ALL THE LATEST IMPROVEMENTS,

MANUFACTURED ONLY BY

PRIZE MEDALS.
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THE GAS-METER COMPANY, LIMITED,

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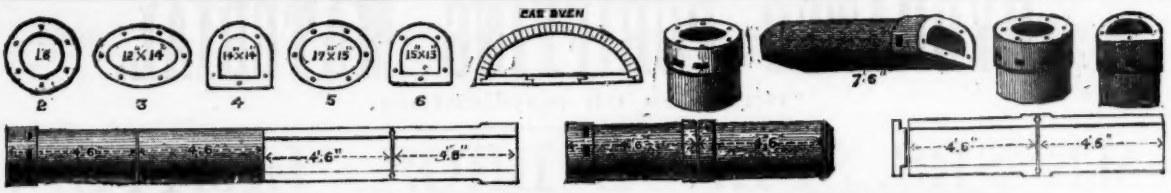

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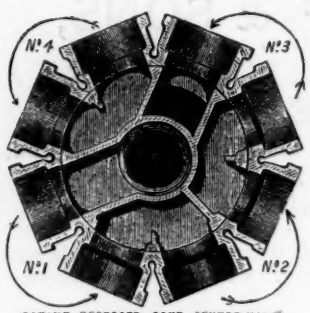
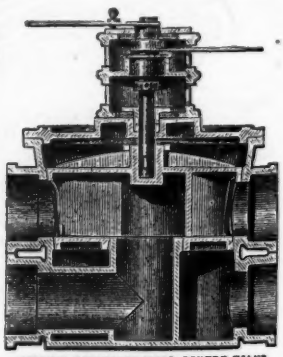
CAST-IRON GAS AND WATER PIPES,
WROUGHT IRON AND LEAD TUBING, GLAZED DRAIN-PIPES,
STAFFORDSHIRE BLUE BRICKS.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Plan.

R. LAIDLAW AND SON,
EDINBURGH AND GLASGOW,
SOLE MAKERS OF
PATENT
RECESSED CONE CENTRE-VALVES,
Constructed on the principle of the ordinary Plug-Cock.
THROUGH-WAY & FOUR-WAY COCKS
Of all descriptions.


PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

LONDON OFFICE: 106, CANNON STREET.

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Invite the attention of Gas Companies, Corporations, and others to their
PATENT STREET LAMPS,
Which are so constructed that neither putty nor other materials are required to secure the glass. No hacking out of old putty, which frequently destroys the frames. A new pane of glass can be inserted in two or three minutes by any inexperienced person, the glass being secured by a hinged flap and turn button.

PRICE 10s. each, net. Special quotations for large quantities.
Also made **EXTRA STOUT** recommended for its durability, PRICE 11s. 6d. each.

D. HULETT'S IMPROVED SERVICE CLEANSER,
By the use of which stoppages in service and other pipes are freed from naphthaline and other obstructions in a few minutes. PRICE 73s. net.

HULETT'S PATENT MERCURIAL REGULATOR,
For inserting in mains, to prevent the excess of pressure in high ground, or other elevated positions.

PATENTEES OF IMPROVED WET AND DRY GAS-METERS.
Makers of all kinds of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.
GAS HEATING AND COOKING STOVES.

55 and 56, HIGH HOLBORN, LONDON.

London: Printed by WILLIAM BOUGHTON KING (at the office of Clayton and Co. 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, July 30, 1878.